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Reducing the Concentration of Copper

Shotgun Brand Benelli Super Nova Model

Highlights

Forecasting COVID-19 with Importance

Mapping and Sampling of the Tailing Pond

Discovering Thoughts, Inventing Future

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Forecasting COVID-19 with Importance Sampling and Path-Integrals

By Lester Ingber
Physical Studies Institute LLC

Abstract- *Background:* Forecasting nonlinear stochastic systems most often is quite difficult, without giving in to temptations to simply simplify models for the sake of permitting simple computations.

Objective: Here, two basic algorithms, Adaptive Simulated Annealing (ASA) and path-integral codes PATHINT/PATHTREE (and their quantum generalizations qPATHINT/ qPATHTREE) are suggested as being useful to fit COVID-19 data and to help predict spread or control of this pandemic. Multiple variables are considered, e.g., potentially including ethnicity, population density, obesity, deprivation, pollution, race, environmental temperature.

Method: ASA and PATHINT/PATHTREE have been demonstrated as being effective to forecast properties in three disparate disciplines in neuroscience, financial markets, and combat analysis.

Results: Not only can selected systems in these three disciplines be aptly modeled, but results of detailed calculations have led to new results and insights not previously obtained.

Keywords: *path integral, importance sampling, financial options, combat analysis.*

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Forecasting COVID-19 with Importance Sampling and Path-Integrals

Lester Ingber

Abstract- ***Background:*** Forecasting nonlinear stochastic systems most often is quite difficult, without giving in to temptations to simply simplify models for the sake of permitting simple computations.

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Method: ASA and PATHINT/PATHTREE have been demonstrated as being effective to forecast properties in three disparate disciplines in neuroscience, financial markets, and combat analysis.

Results: Not only can selected systems in these three disciplines be aptly modeled, but results of detailed calculations have led to new results and insights not previously obtained.

Conclusion: While optimization and path-integral algorithms are now quite well-known (at least to many scientists), these applications give strong support to a quite generic application of these tools to stochastic nonlinear systems.

Keywords: path integral, importance sampling, financial options, combat analysis.

I. Introduction

It is generally recognized that the spread of COVID-19 is affected by multiple variables, e.g., potentially including ethnicity, population density, obesity, deprivation, pollution, race, environmental temperature (Anastassopoulou *et al*, 2020; Bray *et al*, 2020; Li *et al*, 2020). Also, the Centre for Evidence-Based Medicine (CEBM) regularly cites papers on the dynamics of COVID-19 at https://www.cebm.net/evidence-synthesis/transmission-dynamics-of-covid-19/.

This proposal offers the application of two basic multivariate algorithms to fairly generic issues in forecasting. As such, they may be useful to fit COVID-19 data and to help predict upcoming spread and control of this pandemic.

(a) Adaptive Simulated Annealing (ASA) developed by the author (Ingber, 1993a) is an importance-sampling optimization code usually used for nonlinear, nonequilibrium, non-stationary, multivariate systems.

Author: Physical Studies Institute LLC, Ashland, OR, USA.
e-mail: ingber@caa.caltech.edu

(b) PATHINT is a numerical path-integral PATHINT code developed by the author (Ingber, 1993b) used for propagation of nonlinear probability distributions, including discontinuities.

These codes were developed by the author and applied across multiple disciplines.

There is not "one size fits all" in forecasting different systems. This was demonstrated for three systems (Ingber, 2020b), where the author has addressed multiple projects across multiple disciplines using these tools: 72 papers/reports/lectures in neuroscience, e.g. (Ingber, 2018; Ingber, 2021), 31 papers/reports/lectures in finance, e.g. (Ingber & Mondescu, 2003; Ingber, 2020a), 24 papers/reports/lectures in combat analyses, e.g. (Ingber, 1993b; Ingber, 2015), and 11 papers/reports/lectures in optimization, e.g. (Atiya *et al*, 2003; Ingber, 2012), It is reasonable to expect that this approach can be applied to many other projects.

For example, the path-integral representation of multivariate nonlinear stochastic differential equations permits derivation of canonical momenta indicators (CMI) which are faithful to intuitive concepts like Force, Momenta, Mass, etc (Ingber, 1996; Ingber, 2015; Ingber & Mondescu, 2001). Correlations among variables are explicitly included in the CMI.

II. Data

A large and updated database for COVID-19 is maintained by the John Hopkins University (JHU) at https://github.com/CSSEGISandData/COVID-19/blob/master/archived_data/archived_daily_case_up-dates/01-21-2020_2200.csv. This database was used for a pilot study.

a) 50+ Locations

The data being used contains 3340 cities throughout the US and some territories. The locations have been broken into 57 States and Territories ready for production runs.

III. Technical Considerations

If there is not time to process large data sets, then the data can be randomly sampled, e.g., as described in another paper, "Developing bid-ask probabilities for high-frequency trading" (Ingber, 2020a).

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If the required forecast is longer than the conditional distribution can sustain, PATHINT/ PATHTREE can be used to propagate the distribution.

The dataset should be broken into independent Training and Testing subsets, to test the trained distribution. If this is not possible, e.g., because of data or time limitations, at the least experts can be used to judge if the model is ready for real-time applications, e.g., the Delphi method (Okoli & Pawlowski, 2004).

If an algorithm like ASA is to be used across a large class of problems, then it must be tunable to different classes. Over the 30+ years of ASA development, the author has worked with many volunteers who have contributed valuable ideas, modifications and corrections to this code. This has resulted in over 150 ASA options that can be used for additional timing additional tuning making it useful across many classes of problems.

The path integral algorithm includes its mathematical equivalents, a large class of stochastic differential equations and a large class of partial differential equations. The advantages of the path integral algorithm are:

(a) Intuitive description in terms of classical forces, inertia, momentum, etc., leading to new indicators.
(b) Delivering a cost function derived from a Lagrangian, or its Action (Lagrangian x dt). Sometimes constraints need to be added as Lagrange multipliers, as was required for normalization requirements in financial risk projects (Ingber, 2010).

IV. Pilot Study

The shape of the spread of this virus is clearly nonlinear. A simple model was used for a pilot study to at least capture some nonlinearity. For example, just using the daily number of total cases reported, C, the short-time conditional Probability $P(t+1|t)$ is given in terms of its effective Lagrangian L, $P = \exp(L_{eff}dt)$ (including the logarithm of the prefactor normalization as it may contain nonlinearities as modeled here):

$$L_{eff} = [(x_{t+1} - x_t - g_x dt)g_{xx'}(x'_{t+1} - x'_t - g_{x'}dt) + 1/2\log(2\pi dtg^2)$$

$$g_x = a\exp(x^b)$$

$$g_{xx'} = c\exp(x^d)$$

$$g = \det(g_{xx'}) \quad (1)$$

with parameters to be fit to data $\{a, b, c, d\}$. This is a simple one-factor model. In more than one dimension, g_{xx} is the metric of this space, the inverse of the covariance matrix.

For the full data set, 100,000 generated-state iteration-s of this cost/objective function's states over the JHU data gave

$$a = 0.077, b = 0.874, c = 2.79, d = 0.845 \quad (2)$$

a) Comet Profile

These codes were run on XSEDE Comet, for 100000 generated states.

> "Comet is a dedicated XSEDE cluster designed by Dell and SDSC delivering 2.0 petaflops, featuring Intel next-gen processors with AVX2, Mellanox FDR InfiniBand interconnects and Aeon storage. The standard compute nodes consist of Intel Xeon E5-2680v3 (formerly codenamed Haswell) processors, 128
>
> GB DDR4 DRAM (64 GB per socket), and 320 GB of SSD local scratch memory. The GPU nodes contain four NVIDIA GPUs each. The large memory nodes contain 1.5 TB of DRAM and four Haswell processors each. The network topology is 56 Gbps FDR InfiniBand with rack-level full bisection bandwidth and 4:1 oversubscription cross-rack bandwidth. Comet has 7 petabytes of 200 GB/second performance storage and 6 petabytes of 100 GB/second durable storage. It also has dedicated gateway hosting nodes and a Virtual Machine repository. External connectivity to Internet2 and ESNet is 100 Gbps."

Comet is being phased out and users will soon be using the new Expanse platform.

b) Parallel Processing

"Parallel Processing for this project basically is similar to many projects developed by the author as Principal Investigator at the Extreme Science and Engineering Discovery Environment (XSEDE.org) since February 2013. That is "trivial MPI" is used, wherein many simultaneous runs are achieved by simply reading in different data files to ASA, using the "array" feature offered by some XSEDE platforms. As offered in a previous XSEDE Extended Collaborative Support Service (ECSS) ticket:

> Parallelization efficiency is 1 for jobs running on a single core that is max one could get. For multi-threaded apps one can get some to decent bump in speed using multiple cores up to some point before plateauing. However, speed bump with multiple cores often leads drop in parallelization efficiency.
>
> Drawback of using single core is too long run time. Though in this case, you are running array jobs with single core and getting maximum efficiency. This is the ideal situation on 'Comet' because nodes on this machine can be shared. You should explain on Scaling and parallelization efficiency

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section that your application is not multi-threaded and you use single core on comet to run your jobs. This gives efficiency of 1, which is maximum value achievable. However, you run array of jobs in one submission and each job uses a single core. This is most efficient use of resources because node sharing is allowed on Comet. It won't hurt to write that you have consulted XSEDE staff on this matter."

c) Xeon Processor

The full US run was done on the author's P1 Gen 3 Thinkpad with a Xeon processor. Previous runs show full agreement between the Comet and the Thinkpad runs when "-ffloat-store" is added to the compile parameters. A full US run of 100,000 generated states with 3239 non-zero locations took 1 hr 47 min 17 sec. (All runs including subsets of the full US therefore took about twice that long.)

V. All Results

All locations were processed to exclude those with all "0" for all days, 99 of them.

Note that a few locations, those with just sub-location as it turned out, gave parameter values that hit boundaries of assigned parameter maximums or minimums. Since these were few exceptions, the decision was made to keep the default ranges given in Table 1.

Table 1

Par	Min	Max
0	-2	2
1	-2	2
2	0.1	2
3	-2	2

Final Results for all 58 Locations are given in Table 2.

Table 2

RUNS_COVID/asa_usr_out_01-Alabama
final cost value = 0.0006165903

Parameter	Value
0	0.07526909
1	0.7867917
2	0.1
3	1.036661

RUNS_COVID/asa_usr_out_02-Alaska
final cost value = 0.0008660421

Parameter	Value
0	0.03041555
1	0.9221085
2	0.1
3	0.9276368

RUNS_COVID/asa_usr_out_03-Arizona
final cost value = 0.003912767

Parameter	Value
0	0.08377208
1	0.818453
2	0.1
3	1.287453

RUNS_COVID/asa_usr_out_04-Arkansas
final cost value = 0.0004816542

Parameter	Value
0	0.07941101
1	0.7750893
2	0.1
3	1.183597

RUNS_COVID/asa_usr_out_05-California
final cost value = 0.0009490655

Parameter	Value
0	0.06696538
1	0.8527078
2	0.1
3	1.292374

RUNS_COVID/asa_usr_out_06-Colorado
final cost value = 0.000503892

Parameter	Value
0	0.02576714
1	0.875757
2	0.1076587
3	1.033743

RUNS_COVID/asa_usr_out_07-Connecticut
final cost value = 0.006819112

Parameter	Value
0	0.03883795
1	0.7877583
2	0.1499112
3	1.133882

RUNS_COVID/asa_usr_out_08-Delaware
final cost value = 0.004949477

Parameter	Value
0	0.1227538
1	0.6899159
2	0.261152
3	0.9695861

RUNS_COVID/asa_usr_out_09-Diamond_Princess
final cost value = -0.05391078

Parameter	Value
0	-4.98784e-07
1	-1.992295
2	0.1
3	-2

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RUNS_COVID/asa_usr_out_10-District_of_Columbia
final cost value = 0.06929941

Parameter	Value
0	2
1	0.4060976
2	2
3	0.7794162

RUNS_COVID/asa_usr_out_11-Florida
final cost value = 0.0008101027

Parameter	Value
0	0.0844608
1	0.8210241
2	0.1
3	1.270596

RUNS_COVID/asa_usr_out_12-Georgia
final cost value = 0.0002643592

Parameter	Value
0	0.04424673
1	0.8548552
2	0.1
3	1.162738

RUNS_COVID/asa_usr_out_13-Grand_Princess
final cost value = -0.063622

Parameter	Value
0	-6.538724e-08
1	-1.806268
2	0.1
3	-2

RUNS_COVID/asa_usr_out_14-Guam
final cost value = 0.0465182

Parameter	Value
0	0.008877227
1	1.154289
2	0.1
3	1.147461

RUNS_COVID/asa_usr_out_15-Hawaii
final cost value = 0.006862005

Parameter	Value
0	0.01611866
1	1.050401
2	0.1
3	1.102763

RUNS_COVID/asa_usr_out_16-Idaho
final cost value = 0.0007488098

Parameter	Value
0	0.05115676
1	0.8504985
2	0.1
3	1.084733

RUNS_COVID/asa_usr_out_17-Illinois
final cost value = 0.0004481785

Parameter	Value
0	0.06157631
1	0.8171975
2	0.8193241
3	1.021197

RUNS_COVID/asa_usr_out_18-Indiana
final cost value = 0.0003787652

Parameter	Value
0	0.0412226
1	0.8332504
2	0.1
3	0.9823153

RUNS_COVID/asa_usr_out_19-Iowa
final cost value = 0.0003525547

Parameter	Value
0	0.07068677
1	0.7683947
2	0.1387974
3	1.049687

RUNS_COVID/asa_usr_out_20-Kansas
final cost value = 0.0002747757

Parameter	Value
0	0.0456688
1	0.8592813
2	0.1
3	1.161988

RUNS_COVID/asa_usr_out_21-Kentucky
final cost value = 0.0002246308

Parameter	Value
0	0.03505446
1	0.8823249
2	0.1
3	0.9808715

RUNS_COVID/asa_usr_out_22-Louisiana
final cost value = 0.0008015797

Parameter	Value
0	0.1070208
1	0.7072564
2	2
3	0.7402889

RUNS_COVID/asa_usr_out_23-Maine
final cost value = 0.001441506

Parameter	Value
0	0.03198315
1	0.7940144
2	0.1823495
3	0.6823531

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RUNS_COVID/asa_usr_out_24-Maryland
final cost value = 0.002061062

Parameter	Value
0	0.0638636
1	0.7898237
2	0.1
3	1.089192

RUNS_COVID/asa_usr_out_25-Massachusetts
final cost value = 0.004352416

Parameter	Value
0	0.06403747
1	0.7364045
2	0.1
3	1.128749

RUNS_COVID/asa_usr_out_26-Michigan
final cost value = 0.0004323011

Parameter	Value
0	0.04372185
1	0.7974153
2	0.311704
3	0.8720471

RUNS_COVID/asa_usr_out_27-Minnesota
final cost value = 0.0004295167

Parameter	Value
0	0.06178572
1	0.8006544
2	0.1
3	1.253828

RUNS_COVID/asa_usr_out_28-Mississippi
final cost value = 0.000463057

Parameter	Value
0	0.1097083
1	0.6931913
2	0.1054405
3	0.9913985

RUNS_COVID/asa_usr_out_29-Missouri
final cost value = 0.000257466

Parameter	Value
0	0.05215969
1	0.8596338
2	0.1
3	1.055173

RUNS_COVID/asa_usr_out_30-Montana
final cost value = 0.0004428111

Parameter	Value
0	0.03814208
1	0.899361
2	0.1
3	0.9560651

RUNS_COVID/asa_usr_out_31-Nebraska
final cost value = 0.0003267622

Parameter	Value
0	0.04517647
1	0.8218373
2	0.1
3	1.145402

RUNS_COVID/asa_usr_out_32-Nevada
final cost value = 0.001893444

Parameter	Value
0	0.03241173
1	0.9219539
2	0.1
3	1.156847

RUNS_COVID/asa_usr_out_33-New_Hampshire
final cost value = 0.003540204

Parameter	Value
0	0.05990541
1	0.713824
2	1.999386
3	0.5164278

RUNS_COVID/asa_usr_out_34-New_Jersey
final cost value = 0.003764219

Parameter	Value
0	2
1	0.3257865
2	2
3	1.048204

RUNS_COVID/asa_usr_out_35-New_Mexico
final cost value = 0.001152665

Parameter	Value
0	0.1004785
1	0.695894
2	0.6817652
3	0.7827343

RUNS_COVID/asa_usr_out_36-New_York
final cost value = 0.0007147068

Parameter	Value
0	0.04110297
1	0.7541359
2	0.1
3	1.054681

RUNS_COVID/asa_usr_out_37-North_Carolina
final cost value = 0.0003851502

Parameter	Value
0	0.08513204
1	0.7664615
2	0.1
3	1.003618

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RUNS_COVID/asa_usr_out_38-North_Dakota
final cost value = 0.0003929314

Parameter	Value
0	0.04932907
1	0.8614704
2	0.1
3	0.9475553

RUNS_COVID/asa_usr_out_39-Northern_Mariana_Islands
final cost value = 0.0110592

Parameter	Value
0	0.03284899
1	0.6745235
2	0.1
3	0.3440228

RUNS_COVID/asa_usr_out_40-Ohio
final cost value = 0.0004090411

Parameter	Value
0	0.04184926
1	0.8463094
2	0.1
3	1.049081

RUNS_COVID/asa_usr_out_41-Oklahoma
final cost value = 0.0004630219

Parameter	Value
0	0.04501715
1	0.8799497
2	0.3494903
3	0.9048175

RUNS_COVID/asa_usr_out_42-Oregon
final cost value = 0.0009208029

Parameter	Value
0	0.05225226
1	0.816799
2	0.2053155
3	0.9100787

RUNS_COVID/asa_usr_out_43-Pennsylvania
final cost value = 0.0005589026

Parameter	Value
0	0.04241694
1	0.8052484
2	0.1
3	1.015383

RUNS_COVID/asa_usr_out_44-Puerto_Rico
final cost value = 0.000312391

Parameter	Value
0	0.03449601
1	0.9045291
2	0.1
3	1.088644

RUNS_COVID/asa_usr_out_45-Rhode_Island
final cost value = 0.0111474

Parameter	Value
0	0.04708741
1	0.7901072
2	0.1
3	1.442058

RUNS_COVID/asa_usr_out_46-South_Carolina
final cost value = 0.0009722008

Parameter	Value
0	0.09290075
1	0.7718165
2	0.1
3	1.095007

RUNS_COVID/asa_usr_out_47-South_Dakota
final cost value = 0.0003353859

Parameter	Value
0	0.05975135
1	0.7782754
2	0.1
3	0.9210539

RUNS_COVID/asa_usr_out_48-Tennessee
final cost value = 0.0005178384

Parameter	Value
0	0.09073933
1	0.7754924
2	2
3	0.8461525

RUNS_COVID/asa_usr_out_49-Texas
final cost value = 0.0001681769

Parameter	Value
0	0.05172033
1	0.8703259
2	0.1
3	1.330712

RUNS_COVID/asa_usr_out_50-US
final cost value = 1.27974e-05

Parameter	Value
0	0.05285717
1	0.8271716
2	0.1090954
3	1.204249

RUNS_COVID/asa_usr_out_51-Utah
final cost value = 0.003623466

Parameter	Value
0	0.04933961
1	0.8573352
2	0.1
3	1.086935

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RUNS_COVID/asa_usr_out_52-Vermont
final cost value = 0.0008160128
Parameter Value
0 0.006796208
1 0.9282152
2 0.1
3 0.4539584

RUNS_COVID/asa_usr_out_53-Virgin_Islands
final cost value = 0.03999473
Parameter Value
0 0.06337426
1 0.8251611
2 0.1
3 1.064258

RUNS_COVID/asa_usr_out_54-Virginia
final cost value = 0.0001637778
Parameter Value
0 0.05090517
1 0.8072254
2 0.1
3 0.9941458

RUNS_COVID/asa_usr_out_55-Washington
final cost value = 0.0005114633
Parameter Value
0 0.05293824
1 0.8114288
2 0.1
3 1.026359

RUNS_COVID/asa_usr_out_56-West_Virginia
final cost value = 0.0004020269
Parameter Value
0 0.02179989
1 0.9542683
2 0.1
3 0.8805843

RUNS_COVID/asa_usr_out_57-Wisconsin
final cost value = 0.0005233912
Parameter Value
0 0.05836374
1 0.8373115
2 0.1
3 1.251952

RUNS_COVID/asa_usr_out_58-Wyoming
final cost value = 0.0008048018
Parameter Value
0 0.05755666
1 0.7254984
3 0.8178418

VI. Conclusion

Two algorithms are suggested for fitting data and forecasting COVID-19, ASA for importance-sampling and fitting parameters to models, and PATHINT/PATHTREE. These algorithms have been applied to several disciplines — neuroscience, financial markets, combat analysis. While optimization and path-integral algorithms are now quite well-known (at least to many scientists), these previous applications give strong support to application of these tools to COVID-19 data.

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Data Protection Laws Trends: *Practice and Debate*

By Hedaia-T-Allah Nabil Abd Al Ghaffar

Cairo University

Abstract- Technological advancement changed the way everything is being done, providing extraordinary benefits and low costs. People and governments are increasingly adopting new technologies to achieve better performance and financial savings. However, those benefits do not come at no cost; technological advancements (such as Cloud Computing, Artificial Intelligence, Robotics, Internet of Things,..etc) involve several security challenges that may expose countries' national securities. The touchstone in this is data. Data has always been central to national security throughout different historical periods. Intelligence agencies' core of work has always been data; however, the mechanisms of getting and securing data evolved throughout history. Nowadays, the applications of different technologies generate enormous amounts of data that are stored in data centers located in different countries. Data could be traveling across countries and between data centers in a routine process so as to balance loads between data centers of the company. This process contains several security risks because countries lose control and sovereignty over the data generated or collected inside their territories, which exposes the core of nation's sovereignty and national security.

Keywords: data protection, data localization, general data protection regulation, national security, sovereignty, conditional flow of data, privacy shield.

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Data Protection Laws Trends: *Practice and Debate*

Hedaia-T-Allah Nabil Abd Al Ghaffar

Abstract- Technological advancement changed the way everything is being done, providing extraordinary benefits and low costs. People and governments are increasingly adopting new technologies to achieve better performance and financial savings. However, those benefits do not come at no cost; technological advancements (such as Cloud Computing, Artificial Intelligence, Robotics, Internet of Things,..etc) involve several security challenges that may expose countries' national securities. The touchstone in this is data. Data has always been central to national security throughout different historical periods. Intelligence agencies' core of work has always been data; however, the mechanisms of getting and securing data evolved throughout history. Nowadays, the applications of different technologies generate enormous amounts of data that are stored in data centers located in different countries. Data could be traveling across countries and between data centers in a routine process so as to balance loads between data centers of the company. This process contains several security risks because countries lose control and sovereignty over the data generated or collected inside their territories, which exposes the core of nation's sovereignty and national security. This has led states to draft data protection regulations to make sure they keep the data of their citizens and governmental agencies under best control and immune from infringements. In doing this, countries developed different approaches and patterns for data protection. This paper aims at mapping worldwide trends in data protection regulations, highlighting main worldwide models that other countries follow or create their mixtures. Debates about those trends and their implications are highlighted afterwards, and finally some broad criteria are provided so as to benchmark different data protection laws. The paper is theoretically based on the general underpinning of neocolonialism; in the sense that controlling data of nations may be a new form of practicing colonialism and control over countries instead of the traditional political and economic instruments, especially due to the great benefits gained from new technologies that tempt citizens and governments to adopt.

Keywords: data protection, data localization, general data protection regulation, national security, sovereignty, conditional flow of data, privacy shield.

I. Introduction

Data has always been an important resource and the main focus of countries' national security. In an extremely connected world, data generated by new technologies became even more important and in great need to be protected. On the other hand, today's technologies, which contribute greatly to the worldwide economy, are based on the generation of data that is the basis for the Internet and for the growth of Artificial Intelligence, Big Data, Internet of Things, Cloud Computing and other technologies. Balancing between protecting national security while benefiting from new technologies is an extremely difficult task, especially in light of the security risks presented by new technologies that require transferring data across borders. One of the methods countries resorted to in order to achieve both targets is drafting data protection laws and regulations to protect national data from breaches and disclosure. However, countries took several ways and developed different models of data protection laws, some of which infused international debate. Building upon previously published research about government cloud computing and national security [1], the paper tries to answer a simple research question revolving around how do countries differ in protecting their data and national security. The paper tackles the topic of data protection trends between practice and debate; mapping international models and trends of data protection, shedding light on current debates in this regard, and finally presenting some broad guidelines that can help countries choose the most suited data protection alternative.

II. Mapping Data Protection Worldwide Trends

a) *The European Model (GDPR)*

The European Union has been regulating data protection in a very strict way over the years. The General Data Protection Regulation (GDPR) is the current law regulating data protection in EU. It came into effect on the 25th of May 2018 after being approved by the EU Parliament on the 8th of April 2016. By approving GDPR, the predecessor Data Protective Directive, which was regulating data protection in EU since 1995, was consequently obsolete [2]. Even though the Data Protective Directive was doing well-protecting data in the EU, the European data was prone in the last years to several violations, which led to developing the GDPR.

The new GDPR aims at empowering European citizens to control their personal data in a more effective way, in addition to unifying laws regulating data transfer and protection among all European countries, given the fact that the predecessor Data Protection Directive was

Author: Ph.D in Political Science (Comparative Political Systems) – Faculty of Economics and Political Science- Cairo University- Cairo-Egypt. e-mail: hedaia2008@live.com

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not compulsory to EU countries, but more of a non-binding framework. This situation witnessed change with the GDPR, which is binding and compulsory to all EU countries. The GDPR is not only compulsory to European countries but to all other companies and institutions in whatever place, so long as they deal with European citizens' data. The following summarizes main rights guaranteed to European citizens through the GDPR: [3], [4]

- *Increased territorial scope:* Increasing the law's territorial scope is considered one of the major changes that affected the EU data regulatory framework. This goes back to the fact that the new GDPR applies to all companies working with storing and processing personal data of individuals residing in the EU, irrespective of the place of the company. In fact, this came as a remedy to the situation created by the predecessor Data Protection Directive, which was silent and vague about the territorial applicability of the directive. This led to filing many suits about whether to apply the directive or not in different cases. Therefore, the GDPR came out much stronger, compulsory and very clear regarding the territorial applicability of the law. Additionally, non- European data controllers and processors* who process or store European citizens' data are obliged to nominate a representative of the EU, as per Article 3-3 (Official Journal of the European Union: 32,33).
- *Penalties:* One of the most important modifications that were introduced by the GDPR is imposing penalties for the violators; the penalty could reach a maximum of 4% of annual revenue or 20 million euro (whatever is greater), which is the maximum penalty imposed for the strong violations. The penalties system created by the GDPR follows a tiered approach to fines, according to the type of violation. (Article 83)
- *Consent:* The consent of users is firmly regulated in the GDPR, so that the wording of the terms of the agreement should be readable and easily written. Also, the reason for processing data should be clearly stated as well. Most importantly, according to the GDPR, users should have the right to withdraw their consents whenever they want. (Article 7)
- *Breach notification:* The GDPR considers breach notification, within a maximum of 72 hours of finding out 'without undue delay', as a compulsory activity that should be carried out in response to witnessing data breaches, as it endangers users' data integrity and security. (Articles 33,34)
- *Right to access:* The GDPR guarantees the right of the users to get a confirmation from the data controller if their data is being processed or not, and for what reasons. This is in addition to guaranteeing users' rights to get an electronic version of their personal data at the data controller, without any expenses, which is considered a new form of empowering users and securing data.
- *Right to be forgotten/Data erasure:* The GDPR guarantees the right of users to force the data controller to erase their personal data and to stop collecting more data about them whenever the purpose of collecting data comes to an end, whenever the users withdraw the consent they gave in before collecting their personal data and processing it.

On a side note, it is worth mentioning that the GDPR regulates personal data in the EU. Meanwhile, there is the Regulation on the Free Flow of Non-Personal Data that regulates non-personal data in the European Union. Both of the regulations are being applied side by side to create a unified digital single market.

b) The United States Model

The Snowden revelations showed an unstable relationship between IT giant companies and the American security apparatus, based on imposed obligations on IT giant tech companies to reveal users' data so long as data centers are located on the American lands or processed by American companies located outside American territories. This activity is done by means of judicial approval by relevant courts.

These acts led many countries to consider the American companies as untrusted and that their citizens' data are unsafe in their hands. Several counter-reactions have been taken by countries, as will be clear later in the paper. Additionally, disputes were raised between giant tech companies and the American security apparatus, as companies were trying to find ways out of the diminishing trust they are suffering from, creating pressure on American authorities to amend the laws in this regard. Some tech companies, such as Microsoft, sued American authorities for obligations to reveal users' data in Ireland. Also, following the Snowden revelations scandal, IBM started investing billions of dollars for building more than 15 data centers around the world. [5]

No doubt that the American data protection laws are considered loose in comparison to the EU GDPR. In fact; as it is the case with many areas, there is no one common law that all states should be following, but several laws and acts on the federal level, in addition

*It is worth mentioning that the cloud computing environment allows third parties to work with the data, so the data controller may be the same as the data processor and may be a third party. For more information about the cloud computing environment, please revise previous research published by the author.

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to regulations of states pertaining to data protection of citizens inside those states. Some states are considered stricter than others with firm regulations in data protection, such as Massachusetts, which has strong legislation requiring each institution collecting data to provide a detailed plan of securing data. New York has also passed cybersecurity legislation that imposes a minimum requirement of security level. California is also one of the states known for protecting privacy throughout its history. The California Consumer Act has been recently passed and was put in action in 2020. The Act imposes new obligations on companies related to data protection, such as personal data tiering, clarifying how the data will be used, as well as putting restrictions on sharing personal data. The Act involves data subjects' rights such as the right to access data, the right to be forgotten and the right to refuse to share data with a third party. [6]

To sum up, in the United States of America, there is no one independent entity responsible for protecting data, and there is no one framework for data protection to resort to as well. This has resulted in a loose data protection environment in the USA, which completely contradicts with the strict data protection environment in the European Union. To close this gap between the USA and the EU, the European Union has regulated protecting European data when transferred, processed or stored in the USA in a separate way, through the Safe Harbor Agreement that was in effect in 2000. However, the EU Court of Justice declared the Safe Harbor Agreement obsolete in October 2015, in the wake of the Snowden revelations and the Max Schrems case (the Austrian activist who sued Facebook for disclosing European data to the US security apparatus). These incidents proved the Safe Harbor was not capable of protecting the European data and was therefore replaced by a new law, which is the EU-US Privacy Shield Law in July 2016, to guarantee the maximum data protection for European data.

The main difference between both laws lies in the mechanisms of European data transfer to the USA and the related rights and obligations. Main differences can be outlined as follows: [7],[8],[9]

- Increasing the European citizens' rights; the Privacy Shield provides several ways for EU citizens to file complaints and cases about violations of data protection. The Privacy Shield Panel could be a second resort to file complaints and cases if nothing was reached using the traditional ways.
- Intensifying the rigidity of requirements from American companies to be approved to work with EU data; where companies should get approvals, on individual company basis, to work with EU data according to a list of specifications evaluated by a specific panel. According to the Privacy Shield, American companies should prove their abidance to the specifications on an annual basis, or else they are obliged to destroy all the data held.
- Limiting/Constraining the US government reach to European data; where the American ministry of justice as well as the CIA, are restricted by obligations for not reaching EU data. This should be reviewed on an annual basis.
- The third-party who gets the data transferred to or works with processing European data is totally responsible for data and should undergo the same whole process of accreditation, just as the original party.

c) Data Localization Model

It is becoming a matter of fact that the great development in new technologies is imposing threats on national security, and especially with the data revelations cases and incidents. Countries resorted to several ways to protect their data. One of the widest spread techniques is the data and infrastructure localization. Data localization implies passing laws and regulations that confine storing and processing data inside a specific land or geography, or allowing some specific companies to store and process data. [1]

Even though the European model is considered one form of data localization, the author prefers to consider the data localization as a separate trend; because it contains several versions and iterations. And despite the fact that the EU GDPR is part of the data localization model, the author believes that the GDPR can be considered as a separate trend given the fact that it is the most looked-upon model and many countries around the world drafted their data protection laws after the GDPR model.

Data localization comes in different degrees and forms. Data localization trends can be classified according to the following criteria: [10]

i. *Scope of Application*

Some countries impose a clear data localization policy, including all data of the nation, with a 'general scope of application' such as the EU, Russia [11],[12],[13],[14] and some Latin American countries, that impose data localization obligations on all citizens data (i.e. all data should be stored and processed inside the borders of the country). Other countries applied data localization on data of specific sectors that would harm national security, such as the United States that requires storing sensitive data inside its territories, as well as Canada [15]. This last case is closely attributed to the data tiering mechanism that some countries, such as the United Kingdom and the UAE, resort to in order to mitigate the level of data localization; so that data that are classified as highly sensitive would be localized, while data categorized as less sensitive would move

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abroad freely according to concerned laws. The United Kingdom and the UAE impose data localization obligations on health data, for example, as they classify it as highly sensitive data.

Other data and infrastructure localization regulations impose obligations on the importing of IT equipment and require them to be locally produced.

ii. *Level of restrictiveness*

Countries are classified according to the restrictiveness they impose on the transfer of data to several categories, from the strictest to less strict. Studies differ in the number of categories; some classify them into three categories [16], while others classify countries on a continuum of 5 categories [17]. Despite the difference in the number of categories, the core is very similar. The paper adopts the 5-categories classification, as follows:

a. *Strict Localization:* It refers to imposing legal requirements to store and process data in the country, and may potentially include a complete prohibition on cross-border data transfers. It can be said that no one country has applied complete prohibition, but examples of strict regulations are numerous. China has imposed strict data localization requirements for personal information and important data collected by operators of critical infrastructure. Strict (semi-complete) localization requirements in China apply to the health and financial sector. The cybersecurity law in Viet Nam contains a broad and strict localization provision that requires all foreign and domestic suppliers of telecommunications, as well as Internet services (including over-the-top services) offered online to store data locally.

b. *Partial Localization:* Partial localization refers to imposing legal requirements to store data locally, but does not include a prohibition on transferring or storing copies of the data abroad, although specific compliance requirements may be imposed for cross-border data transfer and storage. For example, the Russian Federation and Kazakhstan require companies to store a copy of personal data locally, even if they can otherwise be transferred abroad. So the first two levels are very close, the main difference is whether there is a possibility to transfer copies abroad or not.

c. *Conditional Transfer (Hard/Medium/Soft):* A conditional transfer requirement implies that data can be transferred abroad on conditions of complying with some pre-determined measures. Depending on the design of these compliance requirements, conditional transfers may be categorized as hard, intermediate or soft. Hard compliance measures include strict approvals for transfer, strict regulatory audits, binding corporate rules,..etc. The clearest example is the EU GDPR. Intermediate to soft conditions imply easier compliance requirements, such as the case of Mexico; for transferring personal data abroad, the data protection law of Mexico only requires consent from the users and entering into necessary contracts between data processors and the foreign parties handling the personal data, but no other requirements for prior regulatory approval.

d. *Free Flow of Data:* This pattern implies minimum compliance requirements, or even no one reference for compliance and leaving the floor for companies to ensure data protection. For example, in Canada, any company that transfers personal data abroad is responsible for ensuring compliance with domestic laws, but there are no express restrictions on such transfers. Companies are responsible for designing their template of requirements so as to hold other parties accountable.

Table 1: Regulatory spectrum for cross-border data flows and example countries

Strict data localization	Partial data localization	Conditional transfer: Hard	Conditional transfer: Intermediate/ soft	Free flow of data
Restrictive /Guarded approach		Prescriptive approach		Light-touch approach
China India Indonesia Kazakhstan Nigeria Pakistan Russian Federation Rwanda		Algeria Argentina Armenia Brazil Colombia Cote D'Ivoire Egypt **European Union**	Azerbaijan Bahrain Belarus Ghana Japan Kyrgystan New Zealand Republic of Korea	Australia Canada Mexico Philippines Singapore **United States**

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Saudi Arabia	Georgia	United Arab Emirates
Turkey	Israel	
Vietnam	Kenya	
	Malaysia	
	Morocco	
	Peru	
	South Africa	
	Switzerland	
	Thailand	
	Tunisia	
	Ukraine	
	United Kingdom	

Source: UNCTAD (2021)

A light-touch approach implies that all data, including personal data, can generally flow freely across borders with minimal regulatory requirements (if any). The USA is the prominent advocate of this approach.
A prescriptive regulatory approach entails that cross-border data flows are subject to rigorous compliance requirements. The prescriptive approach falls in the middle of the regulatory spectrum, and typically comprises conditional transfer requirements. The EU is the prominent advocate of this approach.
A restrictive regulatory approach means a complete or partial ban on cross-border data flows for reasons of national security and establishing political control over the domestic Internet. A guarded approach focuses on regulatory measures directed towards economic gains and considerations. Both the restrictive and guarded approaches tend to focus primarily on localization regulations, although their predominant policy rationales are quite different.

III. Debate about the Trends

In a data-driven world, where technological products and applications produce huge amounts of data, and with the increasing incidents of data revelations, especially from the side of giant tech companies dominated by the USA, countries are held in a tight position trying not to lose neither the economic benefits and power of new technologies and data-driven economy, nor their sovereignty and control over their people and resources. Countries are being overwhelmed by manifestations of neocolonialism in the technological world. From here, countries resorted to data protection laws and data localization obligations in a way to keep their control over their data and resources. Reasons behind data localization stipulations are fear of dependence, fear of losing control and sovereignty as well as technical concerns emanating from the security breaches, especially when breaches occur outside the territory [1]. One of the strong reasons is the absence of a strong international framework, augmented by frequent breaches scandals from U.S. giant tech companies.

However, data localization laws and regulations led to a wide debate, skewed towards the idea that data localization is an undesirable trend, leading to negative impacts on the global economy and the development of the Internet. On the one hand, the advocates of the trend believe that through confining storing and processing data within the country borders, nations will be able to protect their data from spying and disclosure and would thereby protect their national security. [5]

On the other hand, proponents of this trend believe that these laws usually fail to meet the announced goal and gradually turn to governments spying on their citizens, which impacts democracy and transparency. Most importantly, proponents argue that these kinds of laws negatively impact the growth of the global economy, impede the growth of other technologies that are based on the free flow of data (such as IoT [18], AI and Big Data), as well as threatening the development of Internet and relevant applications. Proponents are afraid that the prevalence of such laws may lead to fragmenting the global Internet infrastructure, which would be a major retreat in the development of the Internet society.[19]

In this regard, Internet Society has recently developed some critical principles upon which the foundations of Internet freedom were based. Internet Society provides training in different countries to support the idea that data localization laws hit the critical principles of the freedom on Internet; precisely Critical Property 1 – An open and accessible infrastructure with a common protocol, Critical Property 3 – Decentralized management and a common distributed routing system and Critical Property 5 – A Technology Neutral, General-Purpose network. [20]

IV. Where to Stand

Given this hot debate, and the wide diversity of data protection trends worldwide, studies developed some guidelines that can work as assessment criteria for countries to assess where to stand in this wide diversity in practice and controversial debates. The paper presents two frameworks for assessing data protection regulations, fulfilling both contradicting views about data localization; protecting national security and allowing for freedom of the Internet, and allowing for assessing the country's specific particularity and

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interests as well. Countries are supposed to make the most suitable mix and match from all variables, according to each one's interests, views and strategies.

The first is a group of elements to be assessed regarding data protection stipulations to ensure de jure privacy control and national security. Countries are expected to draft strong data protection regulations so that the following benchmarks apply: [21]

- Severity of requirements in the law that ensure

i) *Control:* individuals have control over their data.
ii) *Safety:* Personal data is safe in the hands of the organizations.

- Severity of compliance mechanisms that ensure

i) *Enforcement:* mechanisms that increase the likelihood of detection
ii) *Sanctions:* strong penalties that deter violations

On the other hand, countries can assess to what extent will data localization benefit the economy through an assessment framework for different localization options. The assessment tool uses scored methodology and takes into consideration several factors for each localization alternative to finally reach a total score for each alternative so as to help the decision-making process [22]. Put simply and concisely, the model measures the impact of data localization alternatives on economic growth and data access, through the following sub-factors:

- Economic growth

i) *Demand for goods and services:* Assessing if building the infrastructure for local storage would create additional demand for goods and services (such as building data centers and the related components) which would consequently lead to creating direct and indirect job opportunities and therefore boost economic growth. However; demand could be affected by the value of imported equipment required for data centers. The overall impact on economic growth would depend on whether the demand would be met through domestic goods or through importing. Weighing those variables would give insights to decision makers about the best option of data protection regulations.

ii) *Competitive advantage of national firms vs. multinational firms:* Countries should assess the costs of data localization from several perspectives. Mandating data localization would require more capital expenditure as a result of the costs of data storage and processing capabilities. Operational expenditure would also increase as a result of the costs of renting or operating data-related infrastructure. Additionally, having to protect data would require additional policy measures. The total cost related to data localization may render multinationals much more competitive than national firms as a result of economies of scale.

iii) *Risk of retaliation against the country's national firms abroad:* The analysis should also measure the risk of other countries retaliating against localization measures taken by the country. Such actions might lead other countries to impose localization restrictions of their own on the other countries' firms that export services.

iv) *Risk of foreign businesses exiting:* Assessing the risk of data loss due to firms choosing to leave or not enter the country due to localization requirements.

- Data access

i) *Scope of access:* Assessing which localization option would grant the country access to the largest amount of personal data. Risk of retaliation is significant in assessing the scope of access. Countries may resort to bilateral or multilateral agreements instead of enforcing localization if this would give more access to data.

ii) *Speed of access:* Since speedy access to personal data is very crucial in crime investigations, speed of access is important in this analysis, since delays can drastically reduce the likelihood of success.

IV. Conclusion

Data protection regulations and data localization trends are some of the most debatable issues in the international arena. The twinning between data protection in the current technological environment and national security is on top of most countries' agendas. The paper presented a mapping of the worldwide trends in data protection, presented the two points of view in this regard, and tried at the end to provide some kind of guidelines for countries to assess the best-suited alternative of data protection. As shown, choosing the optimum level of data security is a tough task, requiring achieving an accurate balance between economic and political considerations to achieve security without harming the economy.

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To my beloved mum...Grateful for your love and support.

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Griess Test Affection (A and B) by Transmission of Contaminants inside the Barrel of the Shotgun Brand Benelli Super Nova Model

By Jorge Gerardo Forero Paredes, German Camilo Rodríguez Méndez & Patrullero Julián Camilo Murillo Leal

Técnico Profesional en Balística

Abstract- The present investigation arises from the need to investigate and to experiment scientifically if the contaminants established as controlled variable and not contralada can affect performing the procedure described in clause 4.1 of guide 2DC-GU-0024 on "performing ballistic testing on weapons (firearms, pneumatic, gas, black powder, detonating, electrical, etc.) and entering ballistic identification systems."; It can be reasonably inferred that by performing the forty-two tests, manipulating solutions A and B of the Griess reagent, it is evident that the pollutants transferred to the Interior of the Cannon (4-stroke oil, diesel and gasoline) do not affect the results for the identification of nitrites Product of combustion during the Shooting phenomenon. Case contrary, It happens with rainwater, since it is observed that the same it affects the elaboration of the test, taking into account that without coming into contact with the gunpowder, results in a faint pink coloration, indicating in a preliminary way that it is Positive for presence of nitrites.

Keywords: *griess A and B, nitrites, nitrates, deflagration, combustion.*

GJHSS-H Classification: *FOR Code: 090499*



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Griess Test Affection (A and B) by Transmission of Contaminants inside the Barrel of the Shotgun Brand Benelli Super Nova Model

Afectación Prueba Griess (A Y B) Por Transmisión De Contaminantes Al Interior Del Cañón Del Arma De Fuego Tipo Escopeta Marca Benelli Modelo Súper Nova

Jorge Gerardo Forero Paredes [α], German Camilo Rodríguez Méndez [σ]
& Patrullero Julián Camilo Murillo Leal [ρ]

Resumen- La presente investigación surge de la necesidad de indagar y experimentar científicamente si los contaminantes establecidos como variable controlada y no contralada pueden afectar la realización del procedimiento descrito en el numeral 4.1 de la guía 2DCGU-0024 "realizar procedimientos balísticos a las armas (de fuego, neumáticas, de gas, fisto, detonadoras, eléctricas, entre otras) e ingreso a los sistemas de identificación balística"; se puede inferir razonablemente que al realizar los cuarenta y dos ensayos, manipulando las soluciones A y B del reactivo de Griess, se evidencia que los agentes contaminantes transferidos al interior del cañón (aceite 4 tiempos, diésel y gasolina) no afectan los resultados para la identificación de nitritos producto de la combustión durante el fenómeno del disparo. Caso contrario ocurre con el agua lluvia, ya que se observa que el mismo afecta la elaboración de la prueba, teniendo en cuenta que sin entrar en contacto con la pólvora deflagrada, arroja como resultado una coloración rosada tenue, que indica de forma preliminar que es positiva para presencia de nitritos.

Palabras Clave: griess A y B, nitritos, nitratos, deflagración, combustión.

Abstract- The present investigation arises from the need to investigate and to experiment scientifically if the contaminants established as controlled variable and not contralada can affect performing the procedure described in clause 4.1 of guide 2DC-GU-0024 on "performing ballistic testing on weapons (firearms, pneumatic, gas, black powder, detonating, electrical, etc.) and entering ballistic identification systems."; It can be reasonably inferred that by performing the forty-two tests, manipulating solutions A and B of the Griess reagent, it is evident that the pollutants transferred to the Interior of the Cannon (4-stroke oil, diesel and gasoline) do not affect the results for the identification of nitrites Product of combustion during the Shooting phenomenon. Case contrary, It happens with rainwater, since it is observed that the same it affects the elaboration of the test, taking into account that without coming into contact with the gunpowder, results in a faint pink coloration, indicating in a preliminary way that it is Positive for presence of nitrites.

Keywords: griess A and B, nitrites, nitrates, deflagration, combustion.

Author α σ ρ: Técnico profesional en Balística. DIJIN.
e-mails: jorge.forero3221@correo.policia.gov.co, german.rodriguez2844@correo.policia.gov.co, julian.murrillo2735@correo.policia.gov.co

I. Introducción

Hablar de justicia ha sido desde la antigüedad dialogar del delito y de los delincuentes, es decir, la justicia ha sido entendida como la aplicación de la ley al hecho criminal y esa aplicación legal para ser justa ha de ser verídica, sujeta a la verdad; es de ahí que la idea de la búsqueda de la verdad tiene como objetivo que las personas encargadas de administrar la justicia tengan con fin esencial el esclarecimiento de los hechos punibles (Trujillo, 2015).

En la normatividad vigente de Colombia, el estado ha legislado mediante la Constitución Política parámetros para el uso de las armas de fuego. Así las cosas, en su artículo 223 enuncia que: "Solo el Gobierno puede introducir y fabricar, armas, municiones de guerra y explosivos. Nadie podrá poseerlos ni portarlos sin permiso de la autoridad competente. Este permiso no podrá extenderse a los casos de concurrencia a reuniones políticas, a elecciones o a sesiones corporaciones públicas o asambleas, ya sea para actuar en ella o para presenciarlas".

Los miembros de los Organismos Nacionales de Seguridad y otros cuerpos oficiales armados, de carácter permanente, creados o autorizados por la ley, podrán portar armas bajo el control del Gobierno de conformidad con los principios y procedimientos que aquella señale Constitución Política de Colombia, (1991).

Prosiguiendo con el tema el Decreto 2535, (1993), por el cual se expiden normas sobre armas, municiones y explosivos, en su artículo 1 ÁMBITO. Señala que la antes referenciada tiene por objeto fijar normas y requisitos para la tenencia y el porte de armas, municiones explosivos y sus accesorios; clasificar las armas; establecer el régimen para la expedición, revalidación y suspensión de permisos, autoridades competentes; condiciones para la importación y exportación de armas, municiones y explosivos; señalar el régimen de talleres de armería y

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fábrica de artículos pirotécnicos, clubes de tiro y caza, colecciones y coleccionistas de armas, servicios de vigilancia y seguridad privada; definir las circunstancias en las que procede la incautación de armas, imposición de multas y decomiso de las mismas y establecer el régimen para el registro de devolución de armas. Las armas, municiones, explosivos y sus accesorios destinados a la Fuerza Pública para el cumplimiento de su misión constitucional y legal, así como su fabricación y comercialización en las empresas estatales no son objeto del presente Decreto.

En vista a lo anterior y teniendo en cuenta la problemática actual de las armas de fuego con las que cuenta la delincuencia; se concluye que se debe entender el objeto de estudio del hecho delictivo realizado desde la criminología, el cual es fundamental para el trabajo de análisis, tanto desde la perspectiva del investigador criminal como la de los especialistas en criminalística, bien sea la de campo o laboratorio; permitiendo con esto un mejor resultado para el trabajo (Trujillo, 2015).

En segundo lugar, de acuerdo a lo antes mencionado, se puede concluir que se hace necesario contar con profesionales en el área del saber de la balística forense, con el fin de contribuir a la seguridad y convivencia ciudadana, mediante el desarrollo efectivo de la criminalística. Moreno, (2012) afirma que:

> La balística es la ciencia que estudia los movimientos, velocidad, fuerza y en general los fenómenos que ocurren en la trayectoria de todo cuerpo lanzado al espacio. Este término es tan amplio que abarca misiles, cohetes y proyectiles, no solo los de un arma de fuego, sino también los lanzados a mano como las piedras o los arrojados con cualquier tipo de mecanismo sin que importe su forma o constitución. (p.145)

Se toma como punto de partida que el arma de fuego es un dispositivo mecánico que utiliza como agente impulsor un compuesto químico (pólvora) que al deflagrar o hacer combustión produce la presión de los gases, (por eso se llaman armas de fuego), que empujan los proyectiles los cuales son lanzados al espacio con fuerza y determinada dirección. (Moreno, 2016, p.16). Seguidamente se debe agregar también que como arma de fuego se define la máquina mecánica propuesta a imprimir a un proyectil una energía de movimiento que permita desplazar cierta distancia, para acceder a un objetivo determinado, la fuerza suficiente para lograr los efectos previstos, utilizando para ello como medio de propulsión la deflagración de la pólvora (Avalle, 2015). Además de las anteriores definiciones, se tiene que en la legislación de Colombia el Decreto 2535, (1993), define en su artículo sexto que las armas de fuego son todas aquellas que emplean como agente impulsor del proyectil la fuerza creada por la expansión de los gases producidos por la combustión de una sustancia química.

De acuerdo a lo anterior se puede decir que el concepto de balística interior es el estudio de los fenómenos que ocurren desde el momento en que la aguja percutora del arma golpea el fulminante de un cartucho, hasta que el proyectil abandona la boca de fuego. Dentro de la balística interior se deben tener en cuenta aspectos importantes como el proceso del disparo, hecho aislado que ocurre en fracciones de milisegundos; sus diversas fases se encuentran perfectamente diferenciadas las cuales pueden ser estudiadas separadamente; por esto puede decirse que las fases son: la percusión, la iniciación del fulminante, la combustión del propelente, el proyectil se pone en movimiento, penetración del proyectil del cañón, el proyectil abandona el cañón y por último el retroceso del arma (Trujillo, 2015).

En la actualidad los Técnicos Profesionales en Balística de las diferentes instituciones con función de policía judicial, como lo son el Cuerpo Técnico de Investigación "CTI" y el Instituto Nacional de Medicina Legal y Ciencias Forenses, no emplean la prueba denominada "Determinar residuos de disparos al interior del cañón de un arma de fuego", ya que consideran que esta no es pertinente de acuerdo a los resultados que arroja, puesto que no se puede determinar ni tiempo específico de disparo, ni la cantidad de los mismos, de ahí que, es por esto que se carece de un sustento técnico científico que demuestre que la prueba de Griess A y B se puede ver afectada por contaminantes externos al arma de fuego (Cuesta, Romero Perilla, Osorio Calderón, & Quiroz Alzate, 2016).

En vista a lo anterior, la (Fiscalía General de la Nación, 2008) expidió la Circular 134 del 02 de diciembre del año 2008, donde argumenta que "la prueba de residuos de disparo no es específica para poder establecer realmente si el arma fue disparada coetáneamente con los hechos, debido a que los residuos de disparo permanecen indefinidamente al interior del cañón del arma de fuego" (p. 1). Por tanto, llegados a este punto se procede a plantear como interrogante de investigación: ¿Cuál es la afectación que presenta la prueba Griess "A y B" al interior del cañón del Arma de Fuego Tipo Escopeta Marca Benelli Modelo Súper Nova, en la identificación de nitritos por la trasmisión de los contaminantes aceite, agua lluvia, diésel y gasolina?, teniendo en cuenta que está es el arma de fuego de acompañamiento implementada dentro del Modelo Nacional de Vigilancia Comunitaria Por Cuadrantes por la Policía Nacional de Colombia.

Con el fin de abordar los antecedentes para establecer la afectación de nitritos por contaminantes al interior del cañón del Arma de Fuego Tipo Escopeta, Marca Benelli, Modelo Súper Nova, se referenció el estudio de (Aguilar, 2015) denominado "Residuos de disparo una vía de identificación de calibres de arma de

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fuego incriminadas en delito de homicidios, cuyo objetivo es explicitar la importancia de los residuos de disparo, en el proceso de identificación de calibres de armas de fuego, vinculadas a la comisión de delitos de homicidios". En vista a lo anterior añade:

> Las ciencias forenses incluyen un grupo amplio e interdisciplinario de aplicaciones en la justicia civil y penal de las ciencias (química, física y biología), así como una gran variedad de áreas como la psicología, patología, psiquiatría, entomología, antropología y odontología. La química analítica forense se define como una disciplina aplicada al análisis de las muestras encontradas en la escena del crimen, cuyas conclusiones desempeñan un rol trascendental en la toma de decisiones judiciales. Esta parte de las ciencias forenses se ocupa de la caracterización y de la cuantificación de sustancias químicas como: estupefacientes, explosivos, residuos de disparo, tintas, entre otros, que en la mayoría de los casos se encuentran a niveles traza. (Sosa, 2012, p.19)

Como resultado de lo anterior, se tiene que el estudio químico que se efectúa en el ánima del cañón, tiene como finalidad la detección e identificación de residuos de nitritos ocasionados durante el disparo, demostrando con esto que el arma sí fue disparada recientemente y a partir de estos restos, se podrá comprobar si un arma de fuego ha sido disparada, ya que siempre estarán presentes después de que haya habido una deflagración de pólvora (García, 2016). En segunda instancia concluye (Barrio, 2014), en su artículo titulado "La ciencia forense desde la perspectiva de la química analítica", publicada en el boletín número 46 de la sociedad española de química analítica, que la detección e identificación de partículas de disparos originadas al interior de los mecanismos del arma de fuego puede proporcionar una valiosa información forense, teniendo en cuenta que puede utilizarse para determinar si una persona ha realizado un disparo, y con esto orientar con certeza los indicios e hipótesis dentro de las investigaciones de tipo penal. Según la ENFSI (European Network of Forensic Science Institute) y las normas ASTM (American Society for Testing and Materials), una partícula característica de un GSR (Gun Shot Residue) debe tener un diámetro entre 0.5 y 5 um y poseer un perfil elemental en base a Pb-Sb-Ba. Estos elementos provienen de los materiales iniciadores de la munición, de los componentes del proyectil y por último los del arma de fuego.

Hay que mencionar además que en la investigación técnico - científica de la criminalística se ha implementado y desarrollado técnicas especiales para determinar la existencia o no de residuos de pólvora en varios lugares a través de las pruebas químicas. Este tipo de prueba contempla la investigación de Ion, nitrito, pólvora y nitratos, mediante la aplicación del reactivo difenilamina reactivo de Guttman, para la identificación de nitratos la cual origina una coloración azul cuando es positiva; y para la identificación de nitritos se tiene los reactivos Griess A y B, descubierta por Peter Griess y aplicada por Walker y Kirk (Palacios, 2015). Hay que mencionar, además también que (Torres & Espitia Cifuentes, 2005) mencionan en el trabajo de grado denominado "Análisis de residuos de pólvora al interior del cañón de arma de fuego", que los diferentes tipos de pólvora (WOLF, NK, 9387, INDUMIL, IMI) mediante la microscopia electrónica de barrido con microsonda de dispersión energética de rayos X y espectrofotometría infrarroja se desprende que los componentes de la pólvora son similares para todas las estudiadas en la presente investigación; lo cual supone que los elementos de la pólvora no son los que están causando alteraciones en el momento de realizar la pruebas de Griess.

(AVN, 2012), en su artículo titulado "Marcaje con seriales y colores serán claves para manejo de municiones en el país", manifiesta que de acuerdo a lo indicado por el comisionado Luis Fernández, Director de la Policía Nacional Bolivariana (PNB), es fundamental ejercer un control exhaustivo sobre las municiones, pues son estas las que en el momento de un incidente violento terminan quitándole la vida a las personas, por consiguiente es necesario el diseño de protocolos para regular el suministro de armas y municiones en Venezuela, por lo cual se tiene previsto que las municiones se fabriquen y se diferencien por colores; así las cosas para los miembros de los organismos de seguridad ciudadana se les asignará el color amarillo, a los efectivos de la Fuerza Armada color plata con serial y por último a las academias de formación se le vende munición en plomo.

Por otra parte, es de gran importancia tener en cuenta las diferentes definiciones que se tienen a nivel global de la pólvora en sus diferentes modalidades, las cuales han ido naciendo progresivamente con el transcurrir de los siglos; por las razones anteriores se trae a colación las ilustraciones ofrecidas por algunos escritores, así: Española, (2014) refiere que la pólvora es una mezcla explosiva de distintas composiciones, originariamente de salitre, azufre y carbón, que a cierto grado de calor se inflama, desprendiendo bruscamente gran cantidad de gases, que se emplea casi siempre en granos y es el principal agente de la pirotecnia. Por otro lado define Prieto, (2015) en su trabajo de grado titulado "Producción de Pólvoras Salinas por Vía Húmeda", que la pólvora negra es un explosivo débil, deflagrante, caracterizado por una velocidad de reacción atmosférica, poco sensible a la presión, requiriendo fuerte confinamiento para explosionar.

Es así, que como resultado del descubrimiento de este componente se crea la unidad básica de carga de un arma de fuego, conocida como cartucho; (Yanza, 2010) refiere que el cartucho es un tubo metálico, plástico o de cartón que contiene en su interior los diversos elementos que van a posibilitar el disparo; dentro de sus componentes se encuentra en la base el fulminante, seguidamente la pólvora y luego se

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halla un tapón que puede ser disco de cartón o plástico, trapos, hilos que separan la pólvora de la carga, llamado taco o pistón de potencia, delante de este se encuentra la carga del cartucho, la cual usualmente son esferas de plomo que se denominan perdigones o postas, que en nuestro entorno es conocido como munición.

Llegado a este punto, es importante mencionar que la munición antes descrita es usada básicamente en armas de fuego tipo escopeta, de hombro, de uno a dos cañones de ánima lisa, que pueden ser yuxtapuestas o superpuestas. Es de resaltar que el término escopeta, fue utilizada inicialmente para referirse a piezas de caza de aves, hasta la primera mitad del siglo XIX (Bardales, 2013).

Avanzando en el razonamiento es importante mencionar, que para efectuar un disparo con arma de fuego se debe contar con una mínima serie de partes básicas para producir este fenómeno; en la investigación titulada "Determinar las partes esenciales de la pistola pietro beretta modelo 92 FS calibre 9 mm para producir un disparo", se puede inferir razonablemente que el cañón del arma referenciada hace parte elemental de las 23 piezas que se necesitan para que esta pueda originar una detonación (Grajales, Rodríguez Bernal, Piñeros Jiménez , & Rojas García, 2015).

Dicho lo anterior, se concluye de acuerdo a (Wilberger, Saldati, & Stuke, 2013), que cuando se dispara un arma de fuego, la gran presión de gases impulsa a través del cañón el proyectil hacia el exterior y simultáneamente con él, son emitidas pequeñas partículas que tienen componentes del proyectil, la pólvora y el fulminante denominadas residuos de disparos al interior del cañón, prendas, cuerpo (piel) y/o superficies sobre las cuales se haya disparado el arma de fuego.

Ahora bien, por otra parte se considera que cuando es operado el disparador del arma de fuego, durante el proceso de disparo se depositan en el interior del cañón residuos de pólvora combustionada o semicombustionada, los cuales pueden ser extraídos y observados con la ayuda de un microscopio estereoscopio y consecutivamente sometido al análisis mediante la aplicación de la sustancia química llamada "Griess", la cual reacciona con una coloración rosada intensa siempre y cuando exista despojos de nitritos y nitratos; además de esto se debe tener en cuenta que para el presente estudio el arma no debe haber sido objeto de limpieza o contaminación, la cual podría dar como resultados falsos positivos o falsos negativos (Fiscalía General de la Nación , SF).

Dicho lo anterior para determinar la presencia de residuos de disparos en prendas, Ruiz, Garizabalo Camargo, León Cortes, & Calixto, (2014) afirma que:

> A las muestras de ropa se le aplicó el reactivo químico Griess "A y B", el cual permitió tener una expresión de resultados los cuales fueron comparados y medidos para obtener un método de medición de distancia de disparo con su correspondiente estándar, encontrándose que mediante dicha técnica el técnico en balística puede determinar el rango de distancia o la dispersión de los residuos de disparos. (p.43)

Del mismo modo se tiene que en la investigación desarrollada en el proyecto de grado denominado "Estudio en el interior del cañón del fusil galil calibre 5.56 mm, con munición LC, IMI, IM y PMP, aplicando el reactivo Griess (A y B)", establecen que en los ensayos realizados no se determinaron residuos de disparos al interior del cañón en fusil galil calibre 5.56 mm, con la munición LC, IMI, IM; cosa distinta ocurrió con la munición de fogueo PMP de origen sudafricano, la cual arroja un resultado positivo al momento de practicar la prueba con los reactivos Griess, orientando de esta manera la teoría que la pólvora no significa una variable del resultado negativo en las armas de fuego tipo fusil (Marín, Sánchez Álvarez, & Rincón Vargas, 2011).

En vista a lo anterior la presente investigación, motiva a los suscriptos a investigar posibles factores determinantes, en los cuales la prueba Griess "A y B" pueda variar con el resultado de la misma; para lograr establecer esto, se toma como referencia los siguientes elementos contaminantes (aceite, agua lluvia, diésel y gasolina) que se encuentran en condiciones periódicas dentro del arma de fuego, comprobando así, si estos alteran o no el resultado final de la prueba que se realiza al interior del cañón, permitiendo con esto que el procedimiento descrito en el numeral 4.1 de la guía 2DCGU-0024 "realizar procedimientos balísticos a las armas (de fuego, neumáticas, de gas, fisto, detonadoras, eléctricas, entre otras) e ingreso a los sistemas de identificación balística" se fortalezca y así se constituya en una herramienta de ayuda para el perito en balística.

Por lo hasta acá descrito, la investigación tiene por objetivo general, determinar el grado de afectación que presenta la prueba Griess "A y B", al interior del cañón del arma de fuego Tipo Escopeta, Marca Benelli, Modelo Súper Nova, con la trasmisión de los contaminantes aceite, agua lluvia, diésel y gasolina.

II. Método

a) Tipo de investigación

La presente investigación es de tipo experimental, teniendo en cuenta que se tomaron muestras de residuos de disparos al interior del cañón del arma de fuego Tipo Escopeta, Marca Benelli, Modelo Súper Nova, a fin de evaluar la afectación que pueda presentar los contaminantes agua (lluvia), aceite para motor (4 tiempos), diésel (destilado medio) y gasolina (destilado liviano) al interior del cañón al momento de realizar la prueba Griess A y B, obteniendo de lo anterior un resultado confiable y objetivo; esto

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teniendo como base teórica, lo mencionado por Hernández, Fernández y Baptista (2014), quienes indican que la investigación de tipo experimental, es aquella que requiere la manipulación intencional de una acción para analizar sus posibles resultados.

b) Variables de Análisis

Para la selección de las variables, se toma como punto de partida los contaminantes (aceite para motor 4 tiempos, diésel destilado medio y gasolina destilado liviano) desde el ámbito controlado y el (agua lluvia) como no controlado, teniendo en cuenta que los mismos se encuentran en ambientes cotidianos del diario vivir. De ahí que, con base a lo mencionado por (Abreu, 2012), se infiere razonablemente que los elementos objeto de estudio son convenientes, toda vez que se acogen de acuerdo a las particularidades del qué, cuándo, dónde y cómo; las cuales se desean exponer en la presente investigación.

c) Instrumento de medición

Como instrumento de medición para la recolección y análisis de las presentes variables que se tienen como contaminantes, se toma de forma conveniente, el método cualitativo de la observación y la experimentación, teniendo en cuenta la experiencia desde el ámbito laboral, que ofrecen los señores asesores temáticos, quienes establecen una hipótesis importante al mencionar que en la actualidad la Policía Nacional, no cuenta con un método técnico ni científico para determinar el grado de afectación al realizar el análisis de residuos de pólvora al interior del cañón de un arma de fuego, mediante el uso de los reactivos Griess A y B, toda vez que estos elementos son usados de manera cotidiana por los operadores de las armas, para el mantenimiento de las mismas.

Es por esto, que para la escogencia del instrumento de medición, se toma como base lo mencionado por (Romo, Hernández Sampieri, Leal Pérez, & Mendoza Torres, 2016), quienes afirman que la observación es la enseñanza de las ciencias como una de las materias principales en donde el individuo aprende a desarrollar sus primeras habilidades investigativas al explorar y comprender el mundo natural y social que los rodea. Dicha observación se plasma bajo el análisis descriptivo que se da del desprendimiento de los objetivos específicos planteados en cada una de las fases.

d) Elementos Utilizados

En la fase de campo fue necesario utilizar dos armas de fuego, tipo Escopeta, Marca Benelli, Modelo Súper Nova, calibre 12 Gauge, de series Z718408014 y Z649574B, cincuenta cartuchos, calibre 12 gauge, marca Federal del lote 01 FC, recuperador acuoso, los cuales fueron suministrados por la Dirección de la Escuela de Investigación Criminal "ESINC" a través del grupo de armamento, elementos de bioseguridad y seguridad industrial (tapa oídos, marca 3M, guantes de nitrilo en lates, mascara de gases industrial, marca 3M, gafa industrial, bata de laboratorio y cinta de acordonamiento).

Prosiguiendo con la investigación en la fase de laboratorio, fue necesario utilizar los dos cañones de las escopetas objeto de estudio, plastilina industrial marca Keter, reactivos Griess A y B, tubos de ensayos, marca Hitachi Koki, gradilla en madera, probeta graduada en plástico, recipiente en vidrio de 20 x 40 cm, estopa industrial, Kit de aseo para escopeta, marca beretta (baqueta en madera con tres uniones, cepillo en material de polietileno, cepillo en material de acero, cepillo en material textil, aceite PL-A5, Solvente PL-S5), tela en algodón, elementos contaminantes (aceite comercial para motor 4 tiempos, marca PETROBRAS, agua lluvia, DIÉSEL comercial destilado medio y gasolina comercial destilado liviano), equipo analizador de fluorescencia de rayos X, marca Thermo Scientific, de referencia Niton XL3T, equipo de espectrofotometría infrarrojo por transformadora de Fourier (FTIR), marca Shimadzu, de referencia Prestige - 21 y el equipo cromatógrafo de gases con detector de ionización de llama (FID), marca Varían, de referencia CP 3800, elementos de bioseguridad y seguridad industrial (tapa oídos, marca 3M, guantes de nitrilo en lates, mascara de gases industrial, marca 3M, gafa industrial, numeradores y bata de laboratorio).

III. Procedimiento

Fase I. Componentes

Para establecer la composición química de los reactivos Griess "A y B" usados en el desarrollo de la presente investigación, se manejó el método de reacción de diazotación de Griess, en la que se fundamenta el reactivo de Peter Griess; además de esto cabe señalar que Martínez, (2015) menciona en su trabajo de grado titulado "Análisis de signos característicos en las heridas producidas por el paso de proyectiles disparados por armas de fuego calibre 9 mm con el fin de establecer distancia posición de víctima y victimario", que los nitritos se evidencian específicamente a través de la técnica ideada por J. T. WALKER en 1937, la cual es basada en el uso del "Reactivo de Griess". Este reactivo se basa en dos soluciones:

- ✓ *Solución A:* 50 ml de ácido acético glacial.
  100 ml de agua destilada.
  0,5 g de ácido sulfanílico.
- ✓ *Solución B:* 120 ml de agua destilada y desionizada caliente.
  30 ml de ácido acético concentrado.
  0,1 g de alfanaftilamina.

Al momento de efectuar la práctica se procede a mezclar las soluciones "A" y "B" en una sola, sobre la

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zona a analizar descubriendo posteriormente la presencia de restos o partículas que contengan nitritos, si se obtiene una solución de color rosado, el resultado del análisis es positivo; por el contrario si no se obtiene ningún tipo de coloración en la solución, dicho análisis se considera negativo.

Fase II. Identificación

Con el fin de determinar el porcentaje de residuos de disparos por medio de los reactivos Griess "A y B", se procedió a efectuar cuarenta y dos detonaciones utilizando como herramienta dos Escopeta, Marca Benelli, Modelo Súper Nova, a las cuales se les trasfirió de manera controlada tres contaminantes aceite para motor 4 tiempos, diésel destilado medio y gasolina destilado liviano al interior del cañón, con el ánimo de evidenciar la presencia o ausencia de los restos de disparos mediante catorce repeticiones respetivamente con cada elemento contaminador, el cual mediante el método cuantitativo arroja un resultado porcentual de 100%.

Fase III. Análisis

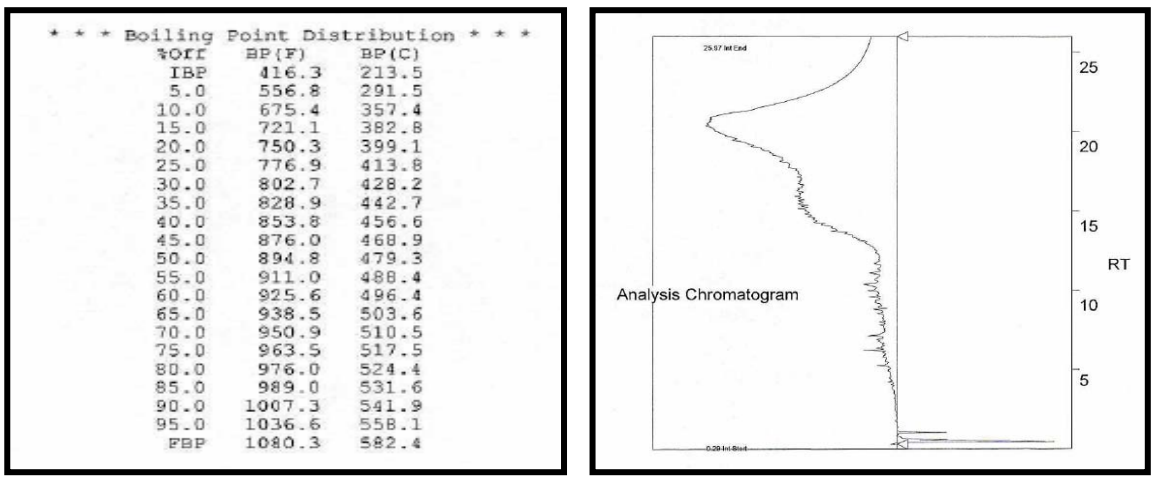
Una vez analizado los resultados obtenidos en las pruebas realizadas con el reactivo Griess "A y B" al interior de los cañones de las dos armas de fuego Tipo Escopeta, Marca Benelli, Modelo Súper Nova, se puedo establecer que los contaminantes aceite para motor 4 tiempos, diésel destilado medio y gasolina destilado mediano, no afectan en la identificación de nitritos producto de la combustión de la pólvora durante el fenómeno del disparo.

Por lo que se refiere al contaminante agua (lluvia), se evidencia que el mismo afecta la realización de la prueba de análisis de residuos de pólvora al interior del cañón, teniendo en cuenta que sin entrar en contacto con la pólvora deflagrada, arroja como resultado una coloración rosada que indica positivamente la presencia de nitritos.

IV. Resultados

De manera análoga con los objetivos específicos, planteados durante el desarrollo del presente artículo científico, se alcanzaron los siguientes resultados, así: Una vez establecida la hipótesis de que en la actualidad la Policía Nacional, no cuenta con un método técnico ni científico para determinar el grado de afectación con los contaminantes aceite para motor 4 tiempos, diésel destilado medio, gasolina destilado mediano y agua (lluvia), al realizar el análisis de residuos de pólvora al interior del cañón de un arma de fuego, mediante el uso de los reactivos Griess A y B, se procedió a enviar al laboratorio de química de la Dirección de investigación Criminal e Interpol, cada uno de los elementos seleccionados como contaminantes para el desarrollo de las pruebas de ensayos, con el fin de identificar la composición física y química de los agentes externos mediante el análisis químico instrumental, obteniendo los siguientes resultados:

Aceite Para Motor 4 Tiempos: Este agente contaminante presenta compuestos principalmente de cadenas lineales parafínicas derivados de los hidrocarburos acompañados de aditivos con bases de compuestos metálicos tales como calcio, magnesio, zinc y fosforo. Ver imagen No.1.



* * * Boiling Point Distribution * * *

%Off	BP(F)	BP(C)
IBP	416.3	213.5
5.0	556.8	291.5
10.0	675.4	357.4
15.0	721.1	382.8
20.0	750.3	399.1
25.0	776.9	413.8
30.0	802.7	428.2
35.0	828.9	442.7
40.0	853.8	456.6
45.0	876.0	468.9
50.0	894.8	479.3
55.0	911.0	488.4
60.0	925.6	496.4
65.0	938.5	503.6
70.0	950.9	510.5
75.0	963.5	517.5
80.0	976.0	524.4
85.0	989.0	531.6
90.0	1007.3	541.9
95.0	1036.6	558.1
FBP	1080.3	582.4

Fuente: Equipo de Cromatografía de Gases con Detector de Ionización de Llama. (FID)

Imagen 1: Perfil Cromatógrafo Aceite

La muestra analizada que se observa en la imagen No.1, presenta un perfil cromatográfico similar al de un aceite lubricante analizado mediante la técnica instrumental Cromatografía de Gases con Detector de Ionización de Llama (FID).

Diésel Destilado Medio: Contiene básicamente una mezcla de hidrocarburos de Cadenas de hidrógenos y carbonos del c4 al c25, con propiedades combustibles líquidos con composición principal de parafinas seguido de una menor proporción de compuestos aromáticos como se detalla en la imagen No.2.

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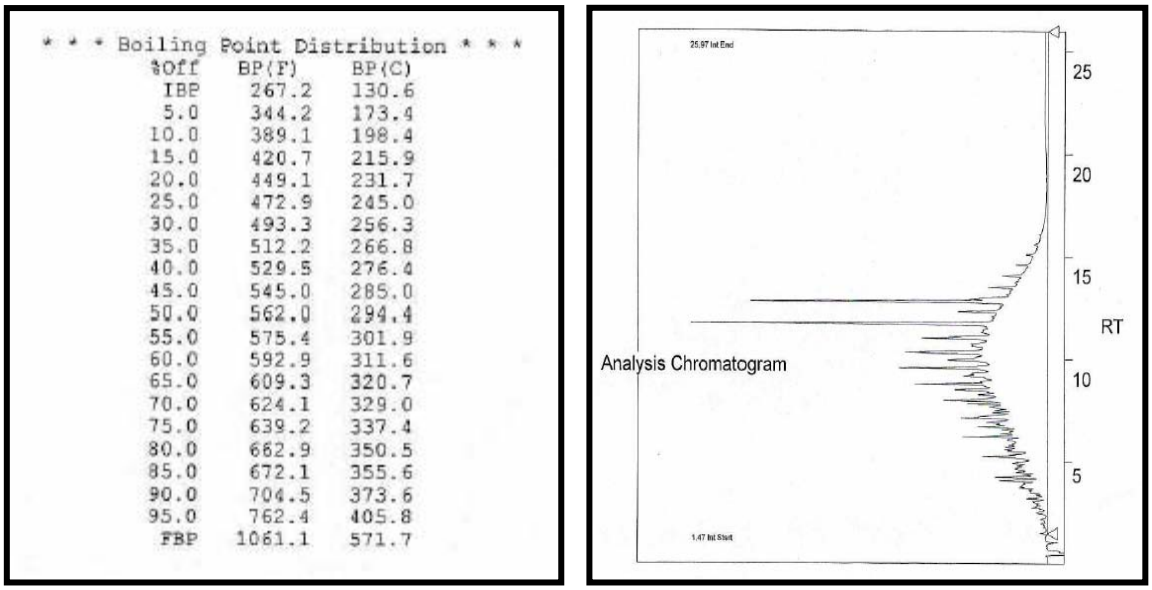


* * * Boiling Point Distribution * * *

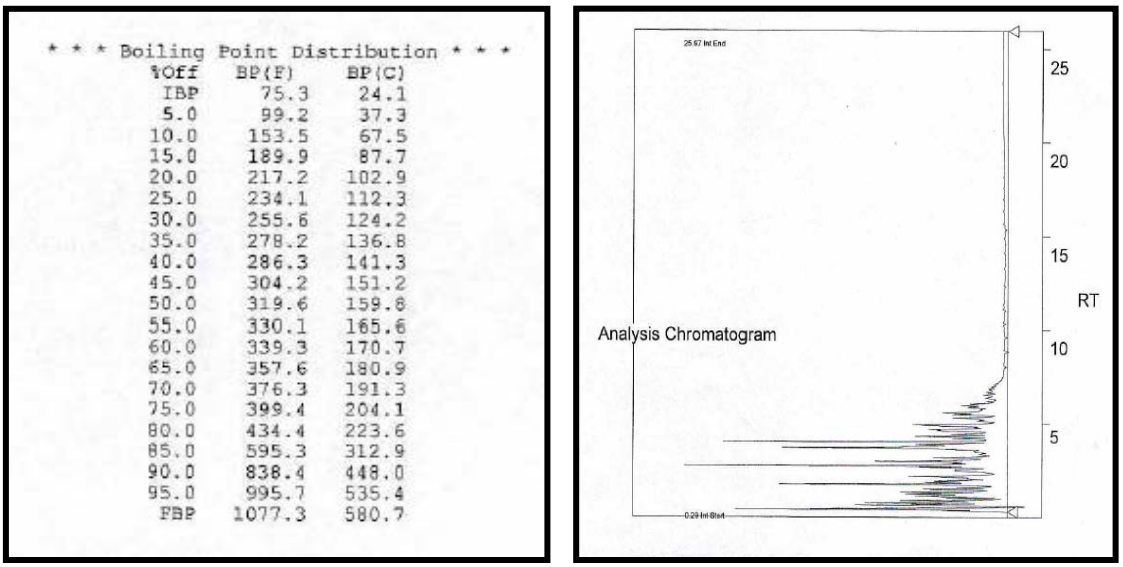
%Off	BP(F)	BP(C)
IBP	267.2	130.6
5.0	344.2	173.4
10.0	389.1	198.4
15.0	420.7	215.9
20.0	449.1	231.7
25.0	472.9	245.0
30.0	493.3	256.3
35.0	512.2	266.8
40.0	529.5	276.4
45.0	545.0	285.0
50.0	562.0	294.4
55.0	575.4	301.9
60.0	592.9	311.6
65.0	609.3	320.7
70.0	624.1	329.0
75.0	639.2	337.4
80.0	662.9	350.5
85.0	672.1	355.6
90.0	704.5	373.6
95.0	762.4	405.8
FBP	1061.1	571.7

Fuente: Equipo de Cromatografía de Gases con Detector de Ionización de Llama. (FID)

Imagen 2: Perfil Cromatógrafo Diésel

El modelo estudiado presenta un perfil cromatográfico similar al de un hidrocarburo medio, tipo diésel analizada mediante la técnica instrumental Cromatografía de Gases con Detector de Ionización de Llama (FID).

Gasolina Destilado Liviano: Una vez realizado el análisis muestra como componentes una mezcla de hidrocarburos de cadenas de hidrógenos y carbonos del c4 al c11, con propiedades combustibles líquidos con composición de parafinas, naftenos, olefinas y aromáticos como se observa en la imagen No.3.



* * * Boiling Point Distribution * * *

%Off	BP(F)	BP(C)
IBP	75.3	24.1
5.0	99.2	37.3
10.0	153.5	67.5
15.0	189.9	87.7
20.0	217.2	102.9
25.0	234.1	112.3
30.0	255.6	124.2
35.0	278.2	136.8
40.0	286.3	141.3
45.0	304.2	151.2
50.0	319.6	159.8
55.0	330.1	165.6
60.0	339.3	170.7
65.0	357.6	180.9
70.0	376.3	191.3
75.0	399.4	204.1
80.0	434.4	223.6
85.0	595.3	312.9
90.0	838.4	448.0
95.0	995.7	535.4
FBP	1077.3	580.7

Fuente: Equipo de Cromatografía de Gases con Detector de Ionización de Llama. (FID)

Imagen 3: Perfil Cromatógrafo Gasolina

El ejemplar examinado presenta un perfil cromatográfico similar al de un hidrocarburo liviano, tipo gasolina analizada mediante la técnica instrumental Cromatografía de Gases con Detector de Ionización de Llama (FID).

Agua Lluvia: Mediante el análisis de la técnica instrumental de Espectroscopia Infrarroja con Transformadas de Fourier (FTIR), la prueba analizada de este contamínate reporta bandas de absorción de agua compuesta químicamente de hidrogeno y oxigeno; mientras tanto por otra parte hay que mencionar, además que al realizar la reacción de identificación de coloración de la prueba de Griess, se observa la formación de una tonalidad rosada tenue al

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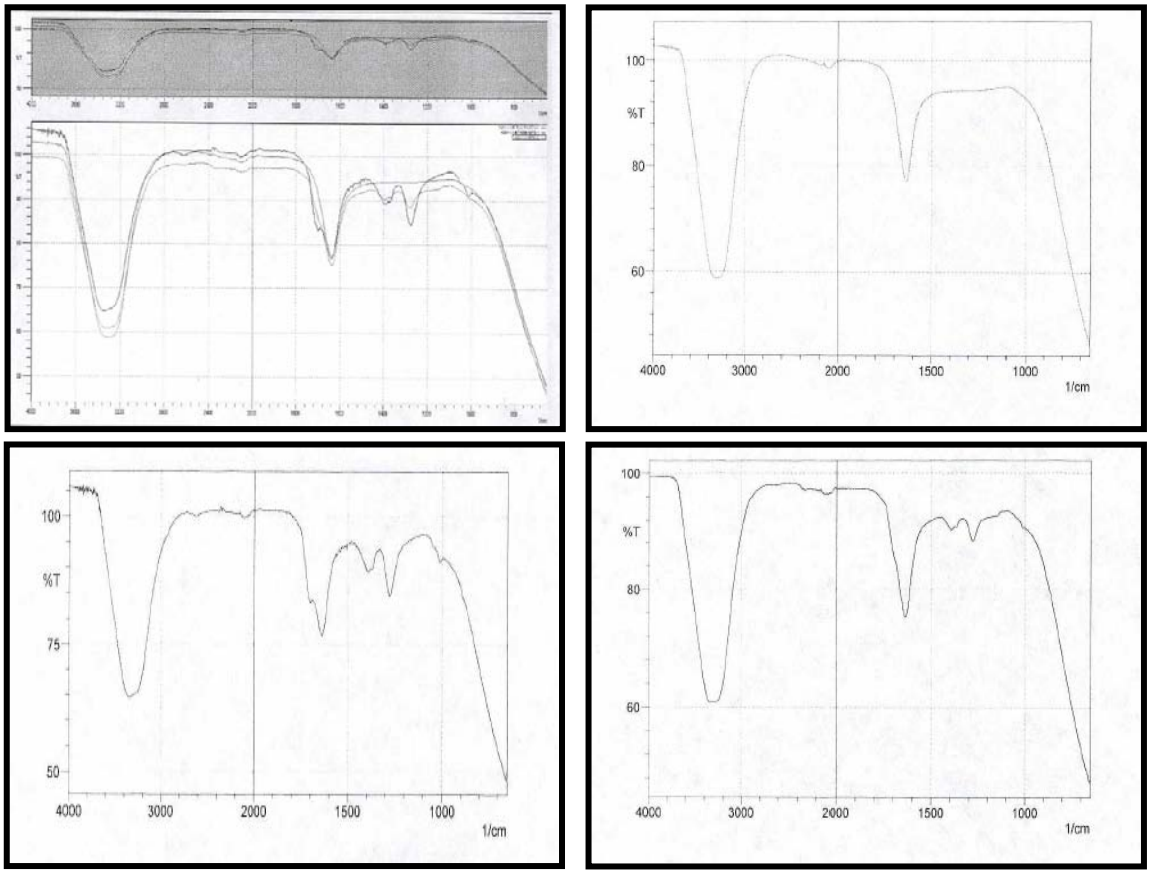
mezclarse las dos soluciones A y B, indicando positivamente la presencia de nitritos para esta variable no controlada.



Fuente: Equipo de Espectroscopia Infrarroja con Transformadas de Fourier. (FTIR)

Imagen 4: Composición Química Agua Lluvia

Cartucho Calibre 12 Gauge: La señalada munición está compuesta principalmente por nitrocelulosa, azufre, nitrato de potasio y carbón, de acuerdo a lo ilustrado en el reporte de la Espectrometría Infrarroja con Transformada de Fourier (FTIR), del equipo IR prestige 21, marca Shimadzu. Por otra parte para identificar los elementos metálicos que se encuentra en el cartucho, se empleó el equipo de Fluorescencia de Rayos X, marca Thermo Scientific, de referencia Niton XL3T, para el análisis químico elemental como aparece en la tabla No.1 y la imagen No.5.

Tabla 1: Propiedades químicas pólvora cartucho calibre 12 gauge

Propiedades Químicas Pólvora Cartucho Calibre 12 Gauge			
Tiempo	Elemento	§	±2Ø
180.2 seg	Silicio (Si)	0.303	0.030
	Fósforo (P)	0.038	0.018
	Azufre (S)	1.90	0.04
	Cloro (Cl)	0.021	0.005
	Potasio (K)	1.29	0.03
	Calcio (Ca)	0.080	0.009
	Titanio (Ti)	0.005	0.002
	Hierro (Fe)	0.004	0.003
	Cobre (Cu)	0.003	0.001

Fuente: Equipo de Fluorescencia de Rayos X, de referencia Niton XL3T

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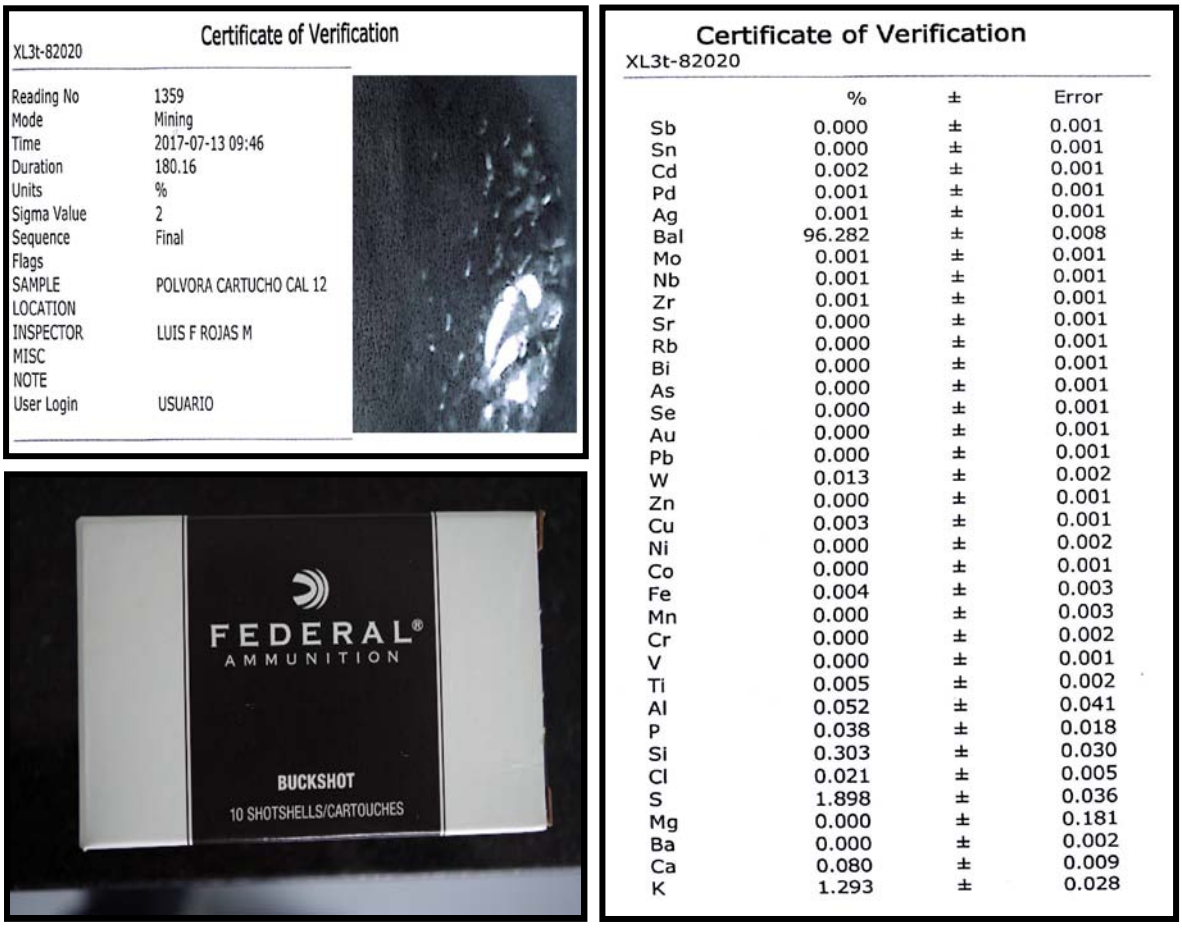

Fuente: Equipo de Espectroscopia Infrarroja con Transformadas de Fourier. (FTIR)

Imagen 5: Reporte de Espectrometría Infrarroja con Transformada de Fourier de la munición federal.

Para establecer las propiedades físicas y químicas del aceite PL-A5 y solvente PL-S5, se toma como referencia los datos suministrados en las hojas de seguridad de la empresa TOBAR & TOBAR S.A.S., allegados a los contratos de compraventas PN DIRAF No.06-2-10139-13 y PN DIRAF No.06-2-10143-13, celebrado entre la Policía Nacional y la firma antes mencionada, cuyo objeto era la adquisición de aceites y solventes. Ver tablas 2 y 3.

Tabla 2: Propiedades físicas y químicas aceite lubricante PL-A5

Propiedades Físicas y Químicas Aceite Lubricante PL-A5			
	DESCRIPCIÓN	**UNIDAD**	**VALOR**
1. BASE Aceite Mineral	Densidad 15°C	Kg/l	0.862
	Viscosidad 40°C	cSt	22
	Viscosidad 100°C	cSt	4.22
	Índice de viscosidad		95
	Punto de inflamación (Copa abierta)	°C	194
	Punto de fluidez	°C	-12
	DESCRIPCIÓN	**UNIDAD**	**VALOR**
2. ADITIVO Compuesto Siliconado	Densidad 25°C	Kg/l	0.968
	Coeficiente térmico de viscosidad		0.60
	Contenido volátil a 150° C	%	0.09
	Pour point	°C	-65
	Punto de inflamación (Copa abierta)	°C	>326
	Punto de fluidez	°C	-27

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	DESCRIPCIÓN	UNIDAD	VALOR
SOLVENTE ADITIVO	Gravedad API		43.1
	Punto de inflamación	°C	38
	Viscosidad 40°C	cSt	2.6
	Color ASTM		5

Fuente: Hoja de seguridad aceite lubricante PL-A5. Flavio Tobar Álvarez., 2013.

Tabla 3: Propiedades físicas y químicas solvente PL-S5

Propiedades Físicas y Químicas Solvente PL-S5			
	DESCRIPCIÓN	UNIDAD	VALOR
1. BASE Liquido solvente	Densidad 15.6°C	Kg/l	0.78
	Índice de refractividad 25°C		1.43
	Contenido aromático	% en peso	0.69
	Punto de anihilina en °C	°C	69.2
	Punto de inflamación (Copa Abierta)	°C	45
	Contenido de sulfuros	ppm	>1
	DESCRIPCIÓN	UNIDAD	VALOR
2. ADITIVO Alcoholes tipo 1	Densidad 20°C	Kg/l	0.81
	Título alcoholímetro a 20°C	% V/V	95.6
	Acidez total	% m/V	0.0005
	Contenido de metanol	% m/V	0.0025
	Color	Und. APHA	5
	Dieftilftalato	% V/V	0.50
	DESCRIPCIÓN	UNIDAD	VALOR
Alcoholes protectores Del tipo 2	Densidad 20°C	Kg/l	1.048
	Punto de inflamación	°C	119
	Punto de ebullición a 1 atmósfera	°C	265
	Índice de refractividad		1.49
	Presión de vapor a 134°C	Mm de Hg	11
	Humedad	%	0.002
3. Aromatizante	Esencia aromatizante de olor característico		

Fuente: Hoja de seguridad solvente PL-S5. Flavio Tobar Álvarez., 2013.

Posteriormente una vez analizados los elementos seleccionados como contaminantes y utensilios para el desarrollo de las pruebas de ensayos, se procedió a materializar en el laboratorio de química de la Escuela de Investigación Criminal, la transferencia de contaminantes de acuerdo a las variables que se tienen como controlada y no controlada, así:

a) Variables controladas

Aceite para motor 4 tiempos, diésel destilado medio y Gasolina destilado mediano: Para iniciar con el procedimiento de investigación, se procedió a tener en cuenta las medidas de seguridad (bioseguridad, seguridad industrial), seguidamente se realizó la prueba de control negativo y positivo a los reactivos y elementos a utilizar dentro de la actividad como se observa en las imagen 6, hallando como resultado que el mismo arroja negativo para la presencia de nitritos producto de la combustión de la pólvora, teniendo en cuenta que no se logra percibir visualmente la formación de ningún tipo de coloración en la solución de Griess aplicada.

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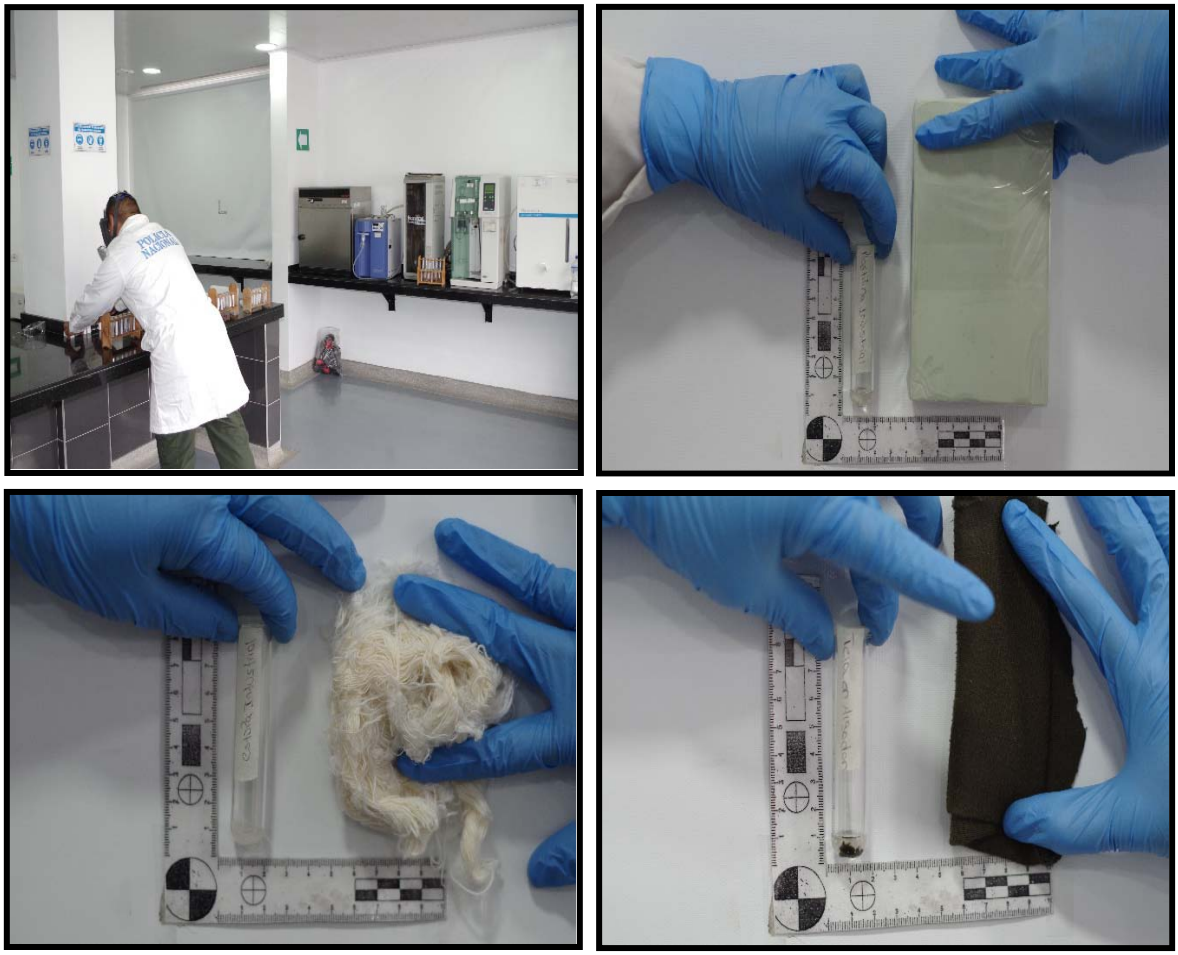

Fuente: Esta investigación 2017.

Imagen 6: Prueba Control Negativo y Positivo

Posterior a esto se efectuaron cuarenta y dos disparos, con dos escopetas marca benelli, modelo súper nova, de series Z718408014 y Z649574B, a los cuales se les transfirieron los contaminantes mencionados, mediante la extracción de los cañones, conforme se iban efectuando las detonaciones una a una, con el fin de impregnar consecutivamente cada una de estas a cada agente; luego de esto se aisló uno de los extremos del cañón con plastilina industrial libre de partículas nitrogenadas, de seguida con el gotero de la solución Griess A, se aplicó diez gotas al interior del cañón, esto teniendo en cuenta la longitud de la pieza, e inmediatamente de igual forma se administró la misma cantidad de gotas de la solución Griess B; es de aclarar que los goteros se usaron de forma independiente con cada uno de los reactivos.

Después de aplicar estas sustancias de Griess, se aíslo el otro extremo del cañón con plastilina industrial y se procedió a agitar el mismo, con el fin de que las dos soluciones actúen sobre los posibles residuos de pólvora que hayan quedado producto de la combustión. A la postre de este procedimiento se destapó uno de los extremos del cañón y dicha solución fue vertida dentro de un tubo de ensayo en óptimas condiciones de limpieza; del anterior procedimiento se observa una sustancia color rosada, que indica que el resultado del análisis es positivo para la presencia de nitritos producto de la deflagración de la pólvora.

Es de aclarar que el procedimiento se efectúo consecutivamente en catorce ocasiones con cada contamínate expuesto al cañón de las escopetas, con el ánimo de evidenciar si el mismo presenta repetitividad en el resultado colorimétrico una vez contaminado con cada agente como se observa en la tabla 3. De igual forma se aclara que, el interior del cañón fue sometido a limpieza con el solvente PL-S5 y el aceite lubricante PL-A5, con el fin de neutralizar la acción del reactivo en el desarrollo de cada análisis.

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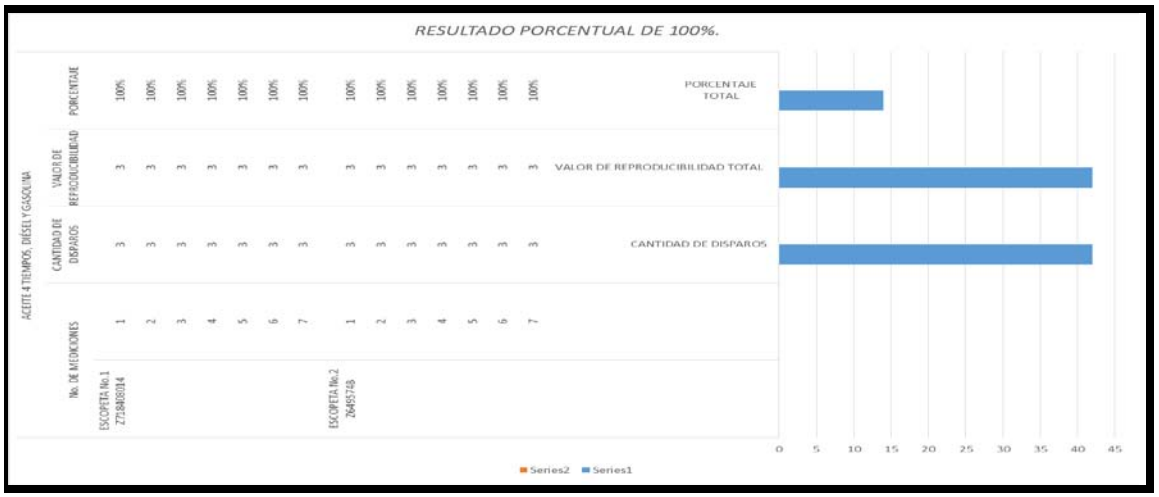
Tabla 3: Resultado porcentual de 100%



Fuente: Esta investigación 2017.

En la descripción de la gráfica representada en la tabla número tres, se puede comprobar visualmente que se realizó cuarenta y dos disparos con las dos escopetas y cada contaminante discriminándolos a siete repeticiones por cada arma, el cual arroja un resultado total porcentual de 100%, es decir que en la praxis del laboratorio la prueba solo se realiza una vez, y en la presente investigación se realizó catorce veces por cada contaminante, aumentando así su valor de reproducibilidad y evidenciando que ésta no es afectada por los agentes expuestos al momento de la identificación de los nitritos productos del fenómeno del disparo.

b) Variable no controlada

Agua lluvia: Con el presente contaminante, se procedió a realizar la prueba de control negativo y positivo a los reactivos y elementos a manejar dentro del análisis, hallando como resultado, que el mismo arroja una coloración rosada, que indica como consecuencia del análisis que es positivo para la presencia de nitritos orgánicos presente en el ambiente; por consiguiente no se procede a efectuar los disparos. Es de anotar que al agua lluvia, se le practicaron las pruebas en catorce repeticiones al interior del cañón, de las cuales todas dieron positivo sin entrar en contacto con la pólvora, toda vez que las piezas se encontraban neutralizadas cuando fueron sometidas a limpieza con el solvente PL-S5 y el aceite lubricante PL-A5.

V. Discusión

Teniendo en cuenta que en el transcurso de la presente investigación, se procedió a establecer la composición química de los contaminantes aceite para motor 4 tiempos, diésel destilado medio y gasolina destilado liviano, con el fin de indagar la posible afectación que esta pueda tener en el desarrollo del análisis con la aprueba Griess A y B al interior del cañón de un arma de fuego, se tiene como resultado final que éstos agentes establecidos como variables controladas, no afectan a la individualización de nitritos adheridos en el ánima del cañón de las dos escopetas experimentadas una vez producido el fenómeno de disparo.

En contraste con lo anterior con el contaminante de la variable no controlada agua lluvia tomada de la ciudad de Bogotá, se tiene que esta presenta afectación en la práctica del estudio con los reactivos de Griess, teniendo en cuenta que al realizar la prueba control de los reactivos dio resultado positivo, indicando la presencia de posibles compuestos nitrogenados (nitritos) al observarse la formación de una coloración rosado tenue al mezclarse las dos soluciones A y B, sin entrar en contacto con la pólvora.

De lo anterior se puede inferir que esta reacción se puede estar presentando, asumiendo como causante el ciclo del nitrógeno. Cirelli, (2012) en su artículo titulado "El agua un recurso esencial", afirma que:

> La mayoría de las plantas pueden absorber nitrógeno sólo en la forma más oxidada, como nitrato, con lo que el amoníaco o el ión amonio utilizados como fertilizantes deben, primero oxidarse por medio de microorganismos antes de ser útiles para la vida de las plantas. Estos procesos de óxido-reducción entre las diferentes especies de nitrógeno, catalizados por microorganismos se conocen como ciclo del nitrógeno. (p.162)

> Seguidamente se debe agregar también que otro factor identificado, es la acidez extra en la lluvia, la cual procede de la reacción de los contaminantes, principalmente el óxido de sulfuro y el óxido de nitrógeno, que con el agua contenida en el aire forman ácidos fuertes, como ácido sulfúrico y el ácido nítrico, aunque también se presenta en menor grado por fuentes naturales (Aristizábal, 2000).

Por lo descrito hasta aquí con la variable no controlada, se recomienda reajustar el contenido documental de esta investigación, teniendo en cuenta

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que en los laboratorios de Balística Forense a nivel nacional, ofrecen dentro de su portafolio de servicio varios procedimientos en los cuales se emplea los reactivos químicos GRIESS; es por ello que se debe realizar esta salvedad y dar a conocer a la comunidad técnico–científica, que este elemento genera interferencias que pueden generar falsos positivos dentro de los procedimientos mencionados al activarse colorimétricamente el reactivo químico en mención.

VI. Conclusiones

Se puede concluir, de manera certera, que los componentes externos como el aceite para motor cuatro tiempos, diésel destilado medio y gasolina destilado liviano, no influyen durante el ensayo de residuos de disparo al interior del cañón de arma de fuego. Por otro lado, es posible obtener un falso positivo en el mismo ensayo si el ánima del arma de fuego tuvo algún tipo de contacto con agua lluvia, por lo cual se enfatiza en los protocolos de recolección y embalaje de evidencias físicas. De igual manera que a partir de las buenas prácticas de laboratorio, el análisis de residuos de pólvora al interior del cañón de un arma de fuego es confiable, siempre y cuando se sigan los protocolos establecidos para el desarrollo de esta, permitiendo con esto que los procedimientos se fortalezcan y así se constituyan en una herramienta de ayuda para el experto en balística.

Finalmente, el tipo de reactivos usados para este tipo de ensayos son muy sensibles en su uso y aplicación debido a que se puede manipular fácilmente su resultado al entrar en contacto con diferentes partículas de materiales, en el caso que nos atañe se descartaron de manera segura aceite para motor 4 tiempos, diésel destilado medio y gasolina destilado liviano, y se tiene conocimiento que al contacto con agua lluvia presenta un resultado erróneo, además se desconoce con qué otros materiales se puede presentar un falso positivo en los resultados.

Conviene subrayar que esta investigación se constituye en un documento técnico-científico pilar para el establecimiento de políticas institucionales, tendientes en orientar mediante la elaboración de dictámenes periciales rendidos a la Fiscalía General de la Nación, la interpretación acertada de los resultados en donde se vean inmersas armas de fuego accionadas en procedimientos conocidos por el personal uniformado, como es el ejemplo del patrullaje urbano y rural de las Fuerzas Militares y de Policía.

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Computational Simulation of the Treatment of Remediation of Metallurgical Effluents to Reducing the Concentration of Copper

By Silvana L. Flores Chávez
Universidad Nacional Mayor de San Marcos

Abstract- The study shows the computational simulation of the treatment of remediation of metallurgical effluents from cupriferous minerals for reducing the concentration of copper ion through the systematization of the influence of each of the variables involved in the referred Treatment, being the operation variables, the independent variables such as: initial concentration of copper dissolved in metallurgical effluent, particle size, temperature, solid-liquid ratio, remediation speed (RPM) and remediation time; and the dependent operation variable will be the final concentration of dissolved copper in effluents; in that sense, this Computational Simulation; the representation of the Systematization of the operation variables from the treatment of remediation of metallurgical effluents from cupriferous minerals, a "Mathematic Model of Computational Simulation from treatment of remediation of metallurgical effluents from cupriferous minerals" which has a discrete and rigurous character and is the result from the influence for each operation variables from the treatment of remediation of metallurgical effluents with high copper load whose equation is: $\text{Ln } \boldsymbol{\alpha} = K\, t$.

Keywords: computational simulation, remediation of metallurgical effluents, cupriferous minerals, water quality standard environmental, class III and IV and supreme decrete 010-2010-MINAM.

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COMPUTATIONALSIMULATIONOFTHETREATMENTOFREMEDIATIONOFMETALLURGICALEFFLUENTSTOREDUCINGTHECONCENTRATIONOFCOPPER

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Computational Simulation of the Treatment of Remediation of Metallurgical Effluents to Reducing the Concentration of Copper

Simulacion Computacional Del Tratamiento De Remediación De Efluentes Metalurgicos Para Reducir La Concentración De Cobre

Silvana L. Flores Chávez

Resumen- El estudio muestra la simulación computacional del tratamiento de remediación de efluentes metalurgicos de minerales cupríferos para reducir la concentración de ión cobre mediante la sistematización de la influencia de la contribución de cada una de las variables que intervienen en el referido tratamiento, siendo las variables de operación, las variables independientes: concentración inicial de cobre disuelto en efluente metalúrgico, tamaño de partícula, temperatura, relación sólido-líquido, velocidad de remediación (RPM) y el tiempo de remediación; y la variable de operación dependiente, es la concentración final de cobre disuelto en efluentes; siendo la representación de la Sistematización de las variables de operación del tratamiento de remediación de efluentes metalúrgicos de minerales cupríferos, un *"Modelo Matemático de Simulación Computacional del tratamiento de remediación de efluentes metalurgicos de minerales cupríferos"* de carácter discreto y riguroso, que es el producto del estudio de la influencia de cada una de las variables de operación del tratamiento de remediación de efluentes metalúrgicos con alta carga metálica de cobre, cuya ecuación será: Ln α = K t.

Palabras Clave: modelo matemático, simulación computacional, tratamiento, remediación de efluentes metalurgicos, minerales de cobre, ECA AGUA- Categoría III y D.S. 010-2010-MINAM.

Abstract- The study shows the computational simulation of the treatment of remediation of metallurgical effluents from cupriferous minerals for reducing the concentration of copper ion through the systematization of the influence of each of the variables involved in the referred Treatment, being the operation variables, the independent variables such as: initial concentration of copper dissolved in metallurgical effluent, particle size, temperature, solid-liquid ratio, remediation speed (RPM) and remediation time; and the dependent operation variable will be the final concentration of dissolved copper in effluents; in that sense, this Computational Simulation; the representation of the Systematization of the operation variables from the treatment of remediation of metallurgical effluents from cupriferous minerals, a *"Mathematic Model of Computational Simulation from treatment of remediation of metallurgical effluents from cupriferous minerals"* which has a discrete and rigurous character and is the result from the influence for each operation variables from the treatment of remediation of metallurgical effluents with high copper load whose equation is: Ln α = K t.

Keywords: computational simulation, remediation of metallurgical effluents, cupriferous minerals, water quality standard environmental, class III and IV and supreme decrete 010-2010-MINAM.

Author: Estudiante de Doctorado en Ciencias Ambientales de la Universidad Nacional Mayor de San Marcos, Peru.
e-mail: silvana.flores1@unmsm.edu.pe

I. Introduccion

Los antecedentes del estudio se vinculan con la problemática a la que se le entregará solución ténica mediante la simulación computacional de la remediación de los efluentes metalúrgicos para reducir la concentración de metal pesado cobre; y asimismo, se considerará los estudios técnicos previos al desarrollo del proyecto donde la problemática de la contaminación global es la generación de acidez en suelos y cuerpo de agua impactados por la industria minera en todos los países.

En el caso del Peru, la problemática se evidencia ne la existencia de más de 8550 "Pasivos Ambientales Mineros" (PAMs): efluentes y relaves metalúrgicos que se encuentran impactando negativamente a 20 regiones del país, ocasionando de esta manera, la contaminación de las Áreas de Influencia del Proyecto de las comunidades aledañas a las operaciones mineras, produciendo la contaminación de cuerpos de agua y suelos que impactan en la calidad de vida del poblador de la comunidad minera; siendo las principales fuentes de contaminación los efluentes metalúrgicos provenientes de operaciones de beneficio metalúrgico del proceso de flotación de minerales sulfurados de cobre y de lixiviación de minerales oxidados de cobre que poseen alta carga metálica tal como: las concentraciones de cobre superiores al de los Límites Máximos Permisibles para la descarga de efluentes Líquidos y que son sometidos a las regulaciones ambientales establecidas por el D.S. N° 010-2010-MINAM y los Estándares de Calidad Ambiental (ECA) para Agua y el establecimiento de sus Disposiciones Complementarias según el DECRETO SUPREMO N° 004-2017-MINAM, la cual es una norma

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tiene por objeto compilar las disposiciones aprobadas mediante el Decreto Supremo N° 002-2008-MINAM, el Decreto Supremo N° 023-2009- MINAM y el Decreto Supremo N° 015-2015-MINAM, que aprueban los Estándares de Calidad Ambiental (ECA) para Agua, quedando sujetos a lo establecido en el presente Decreto Supremo y el Anexo que forma parte integrante del mismo; puesto que esta compilación normativa modifica y elimina algunos valores, parámetros, categorías y subcategorías de los ECA, y mantiene otros, que fueron aprobados por los referidos decretos. Es por ello, que éste tipo de efluentes metalúrgicos provenientes de operaciones de beneficio metalúrgico del proceso de Flotación de minerales sulfurados de cobre y de Lixiviación de minerales oxidados de cobre son sometidos a diversos "Tratamientos de descontaminación de efluentes metalúrgicos" con el objeto de remover y/o eliminar la carga metálica de metales pesados disueltos en los efluentes metalúrgicos; específicamente el cobre que son enviados a presas de relave, que una vez dispuesto el relave en la presa de relave se sedimenta y el efluente líquido filtra y se vierte de manera directa a ríos y lagunas, lo cual ya ocasiona una contaminación ambiental.

Es por ello, importante, desarrollar tratamientos de remediación de efluentes metalúrgicos para reducir la concentración de metales pesados tales como el iòn disuelto de cobre proveniente de los Procesos Metalúrgicos de la Flotación de Minerales y de la Hidrometalurgia; el cual constituye una alternativa de solución para reducir la carga metálica de cobre según ECA AGUA-Categoría III y D.S. 010-2010-MINAM; lo cual se medirá a través del indicador de la eficiencia de reducción al igual que los Tratamientos de Remediación de efluentes metalúrgicos que existen en la actualidad.

Es en ese sentido, los Estudios Técnicos Previos del estudio se vinculan con la informacion del Fundamento Teórico con dos temáticas: tratamiento de descontaminación de efluentes según normativa ambiental (D.S. 010-2010-MINAM y ECA AGUA); así como la temática de simulación y modelamiento matemático como base para generar una simulación computacional para la reducción de concentración de contaminantes de cobre. Estudios Técnicos previos del tratamiento de descontaminación de efluentes metalúrgicos.

En el Perú, se han desarrollado tecnologías de descontaminación y/o remediación de los efluentes metalúrgicos provenientes de la actividad minero-metalúrgica.

II. Métodos y Materiales

La Metodología del Proyecto de Investigación comprende las etapas: trabajo en Gabinete y el Trabajo en Laboratorio, puesto que cada una de las actividades están vinculadas con el tratamiento de remediación de efluentes metalúrgicos de lixiviación ácida y flotación de minerales sulfurados polimetálicos para lograr la reducción de la concentración de cobre disuelto en dichos efluentes metalúrgicos utilizando la Metodología de los Trabajos Técnicos previos de la *"Simulacion Computacional de la remediación de efluentes metalurgicos de lixiviación y flotación de minerales sulfurados polimetálicos para reducir la concentración de metal pesado de cobre"*.

a) Trabajo en Gabinete

El Trabajo en Gabinete involucra el estado del arte vinculadas con las tecnologías limpias de tratamientos de descontaminación de efluentes metalúrgicos. Cabe resaltar, que se empleó información técnica del libro titulado: "Contaminación del medio ambiente por efluentes mineros y metalúrgicos y sus tratamientos de detoxificación con agentes detoxificantes"

b) Trabajo en Laboratorio

El trabajo en laboratorio involucra el trabajo en laboratorio metalúrgico y químico; y asimismo, se realizo y a nivel de laboratorio de ingenieria de sistemas, que a continuación se detalla:

i. *Trabajo en Laboratorio Metalúrgico y Químico*

El trabajo desarrollado en el laboratorio metalúrgico y químico es principalmente la metodología experimental que comprende las etapas de generación de efluentes metalúrgicos con alto contenido de cobre provenientes de procesos metalúrgicos de lixiviación ácida y la Flotación; para posteriormente, ser sometidos al tratamiento de remediación de efluentes metalúrgicos mediante el empleo de agentes remediantes que reducen la concentración del ión cobre y finalmente, someter a una sistematización de las variables que intervienen en el tratamiento de remediación con agente remediante con el propósito de determinar la viabilidad técnica del nuevo tratamiento.

Equipos

- Balanza.
- Celda de Flotación Denver.
- Horno de Tostación.

Materiales

- Mineral Sulfurado de Cobre: Calcopirita.
- Efluente Metalúrgico de Lixiviación y Flotación.
- Espátula
- Papel de Filtro

a. *Actividades Experimentales de la generación del efluente metalúrgico proveniente de lixiviación de sulfato de cobre y efluentes metalúrgicos de flotación en Laboratorio Metalúrgico y Químico.*

Comprende las siguientes actividades según la metodología experimental:

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b. *Actividades Experimentales de la generación del efluente metalúrgico proveniente de lixiviación de sulfato de cobre en Laboratorio Metalúrgico y Químico*

Se realizan las siguientes actividades:

- Preparación Mecánica de Calcopirita: Chancado Primario y Molienda.
- Análisis Granulométrico de Mineral de Calcopirita: Malla +200.
- Tostación de Pellets de Calcopirita a la temperatura: 500°C, 650°C y 800°C.
- Lixiviación Ácida de Pellets Tostados de Calcopirita para la generación de solución de efluente metalúrgico de sulfato de cobre.
- Preparación Mecánica de agente remediante: Chancado Primario y Molienda.
- Análisis Granulométrico del agente remediante: Malla +325.
- Temperatura de síntesis del agente remediante.

Para mayor detalle ver Figura 1.

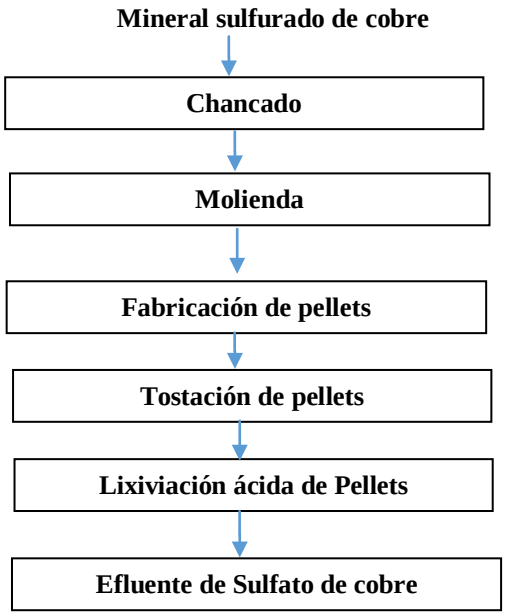

Figura 1: Diagrama de Flujo de proceso de generación de efluente metalúrgico de lixiviación de mineral tostado de calcopirita para la obtención de la solución de sulfato de cobre

c. *Actividades Experimentales en Laboratorio Metalúrgico, Químico de la generación del efluente metalúrgico proveniente de planta de flotación.*

El efluente metalúrgico fue empleado de manera directa de una planta de flotación de minerales sulfurados polimetálicos; es por ello, que el efluente se empleo de manera directa para ser sometido al tratamiento de remediación con el empleo de agente remediante.

ii. *Actividades Experimentales del tratamiento de remediación de efluentes metalúrgicos proveniente de lixiviación de sulfato de cobre y efluentes metalúrgicos de flotación en Laboratorio Metalúrgico.*

La implementación de la metodología Experimental comprende la ejecución de las pruebas experimentales del tratamiento de remediación de efluentes metalúrgicos de lixiviación de sulfato de cobre y los efluentes de flotación provenientes de planta metalúrgica, lo que comprende las actividades experimentales de síntesis del agente remediante previo a la etapa del tratamiento de remediación del efluente metalúrgico y el tratamiento de remediación de efluentes metalúrgicos propiamente dicho, y cuyas actividades a continuación se detalla:

a. *Actividades Experimentales de síntesis del agente remediante.*

Implementa actividades experimentales de síntesis del agente remediante previo a la etapa del tratamiento de remediación del efluente metalúrgico y el tratamiento de remediación del efluente metalúrgico de lixiviación de sulfato de cobre y efluente de flotación, que a continuación se detalla:

b. *Preparación del agente remediante.*

Involucra el estudio de los parámetros y variables de operación que intervienen en el estudio de la "Simulacion Computacional de la remediación de efluentes metalurgicos de lixiviación y flotación de minerales sulfurados polimetálicos para reducir la concentración de metal pesado de cobre"

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A continuación, se detalla los siguientes parámetros y variables; entre los que destacan:

- Parámetros:
  - Condición de Empleo del agente remediante
  - Tiempo de síntesis del agente remediante
- Variables:
  - Concentración inicial de cobre en el efluente metalúrgico.
  - Tamaño de partícula del agente remediante.
  - Temperatura de síntesis del agente remediante.

c. *Actividades Experimentales del tratamiento de remediación de efluentes metalúrgicos proveniente de lixiviación de sulfato de cobre y efluentes metalúrgicos de flotación en Laboratorio Metalúrgico propiamente dicho.*

d. *Actividades Experimentales del tratamiento de remediación del efluente metalúrgico de lixiviación de sulfato de cobre en Laboratorio químico.*

Se realizan las siguientes actividades:

- Análisis Químico de solución del efluente metalúrgico de lixiviación.
- Tratamiento de Remediación de efluentes metalúrgicos de lixiviación con agentes remediantes.

d. *Actividades Experimentales de remediación de Efluente metalúrgico de flotación de minerales en el laboratorio químico.*

Involucra las siguientes actividades:

- Filtración del Efluente Metalúrgico de Flotación.
- Análisis Químico ICP inicial del Efluente Metalúrgico de Flotación.
- Tratamiento de Remediación de Efluente de Flotación mediante el empleo del agente remediante

c) *Trabajo en Laboratorio de Sistemas del Tratamiento de Remediación de efluentes metalúrgicos proveniente de lixiviación sulfato de cobre y efluentes metalúrgicos de flotación basados en la cinética de reducción de la concentración de ión cobre con agentes remediantes.*

El trabajo involucra el desarrollo experimental del método de Sistematización de la influencia de cada una de las contribuciones de las variables independientes de operación que intervienen en el Tratamiento de remediación de cobre.

A continuación, se detalla el tratamiento de la remediación de efluentes metalúrgicos basados en la Cinética de reducción de la concentración de cobre con agentes remediantes

i. *Tratamiento de Remediación de efluentes metalúrgicos de lixiviación de sulfato de cobre basados en la Cinética de reducción de la concentración de cobre con agentes remediantes*

- Condiciones de la Prueba:
  - Peso de agente remediante: 2 gr
  - Tiempo de Molienda: 30 minutos
  - Malla: - 325
  - Temperatura de calcinación: 700°C
  - RPM: 525
  - pH Inicial de la Solución de Lixiviación: 3
  - Volumen de Solución Lixiviante: 100 ml de Solución Lixiviante
  - Porcentaje de reducción de ión cobre: 94.85%

Tabla 1: Cinética de reducción de la concentración de cobre en efluentes metalúrgicos de lixiviación de sulfato de cobre con agentes remediantes tratados

Reducción De Concentración De Cobre		
PESO DE AGENTE REMEDIANTE (gr)	TIEMPO DE REMEDIACIÓN (minutos)	CONCENTRACIÓN DE COBRE (gr/Lt)
2	0	1.185
	15	0.207
	20	0.191
	30	0.061

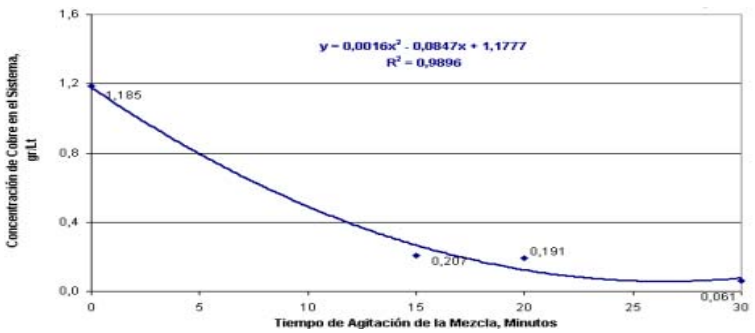

Figura 2: Cinética de reducción de la concentración de cobre con agentes remediantes tratados

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ii. *Tratamiento de Remediación de efluentes metalúrgicos de flotación basados en la Cinética de reducción de la concentración de cobre con agentes remediantes tratados*

- Condiciones de la Prueba:
  - Peso de agente remediante: 2 gr
  - Tiempo de Molienda: 30 minutos
  - Malla: +325
  - RPM: 525
  - Volumen de Solución Lixiviante: 100 ml de Efluente de Planta UNI
  - pH Inicial de efluente: 3
  - pH Final de efluente: 14
  - Porcentaje de Reducción de Cobre: 94.47%

Tabla 3: Cinética de reducción de la concentración de cobre con agentes remediantes tratados

REDUCCIÓN DE CONCENTRACIÓN DE COBRE		
PESO DE AGENTE REMEDIANTE (gr)	TIEMPO DE REMEDIACIÓN (minutos)	CONCENTRACIÓN DE COBRE (gr/Lt)
2	0	0.561
	5	0.164
	10	0.031

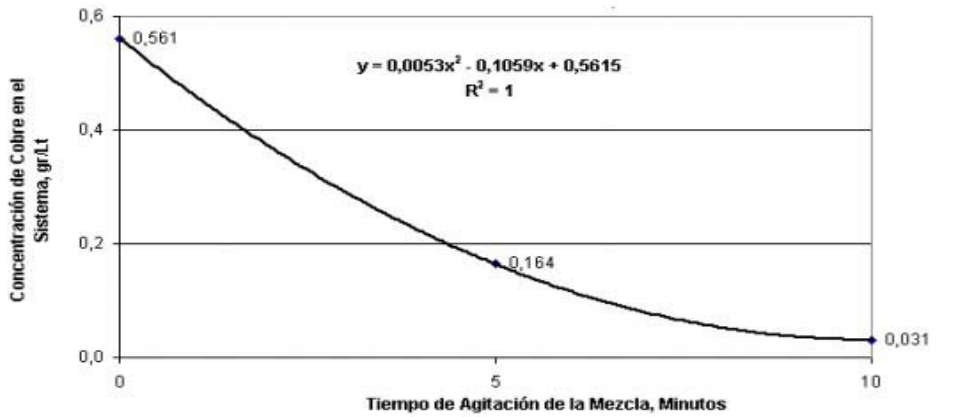

Figura 3: Cinética de reducción de la concentración de cobre con agentes remediantes tratados

III. Resultados y Discusión

Cabe resaltar que la estrategia de investigación del estudio involucra que durante el diseño experimental se analizaron las condiciones óptimas de los parámetros, así como de las variables determinantes dependientes e independientes del tratamiento de remediación de efluentes de lixiviación ácida y efluentes de flotación para lograr la reducción de la concentración de iones cobre.

A continuación, se detalla cada uno de los parámetros y las variables de operación del tratamiento de remediación de efluentes de lixiviación ácida y efluentes de flotación

a) Parámetros

- Condición de Empleo del agente remediante
- Tiempo de síntesis del agente remediante
- Volumen de Efluente Metalúrgico: Flotación y Lixiviación.

b) Variables

- Concentración inicial de cobre en el efluente metalúrgico.
- Tamaño de partícula del agente remediante.
- Temperatura de síntesis del agente remediante.
- Relación sólido-líquido.
- Velocidad de Agitación de la Mezcla: RPM.
- Tiempo de agitación de la mezcla (Efluente Metalúrgico con agente remediante).
- Concentración final de cobre en el efluente proveniente de la lixiviación ácida y Flotación.

Asimismo, se realizó el análisis de las curvas de cinética de reducción de la concentración de cobre con agentes remediantes presente en el sistema (efluente metalúrgico), las cuales indican la reducción de la concentración de ión cobre disuelto inicialmente presente en el efluente metalúrgico hasta valores inferiores cercanos a los indicados por los Límites Máximos del D.S. N° 010-2010-MINAM (0.4 mg/L) y 2 mg/L para el ECA AGUA-Clase III.

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A partir, de lo cual, se deduce que el agente remediante es empleado de manera eficaz y eficiente para el tratamiento de remediación de efluentes metalúrgicos de lixiviación ácida y flotación para reducir la concentración de metales pesados tales como: cobre A continuación, se detallan los resultados y la discusión de cada uno de los parámetros y variables que intervienen en la sistematización y que permitirá sus respectivas contribuciones que intervienen en el Tratamiento de remediación de cobre.

c) *Contribución de las variables de operación, modelo y simulación del tratamiento de remediación de efluentes metalúrgicos.*

La contribución de las variabes de operación tales como: concentración de ión cobre ($K_{(Cu+2)}$; relación sólido/líquido ($K_{(S/L)}$; tamaño de partícula de agente remediante $K_{(Tamaño\ de\ Partícula)}$; rpm $K_{(RPM)}$; temperatura de síntesis del agente remediante (K_T) y el tiempo de agitación de la mezcla durante el tratamiento de remediación de los efluentes metalúrgicos de flotación y de lixiviación de minerales sulfurados y oxidados de cobre respectivamente.

Cabe resaltar, que el modelo matemático sistematiza la influencia de cada una de las variables que intervienen en el Tratamiento de Remediación de efluentes metalúrgicos mediante la Ecuación General que lo represente tal como:

$$\ln \alpha = K\, t$$

$$K = [K_{(Tamaño\ de\ Partícula)} * K_T * K_{(Cu+2)} * K_{(S/L)} * K_{(RPM)}] * t$$

$$\ln \alpha = K\, t \quad K = [K_t * K_{(Tamaño\ de\ Partícula)} * K_{(Cu+2)} * K_{(S/L)} * K_{(RPM)}] * t$$

i. *Discusión de Resultados de Pruebas Experimentales del tratamiento de remediación de efluentes metalúrgicos.*

Considera el análisis de los Diagramas de Simulación de la influencia de las variables de operación que influyen en el tratamiento de remediación de efluentes metalúrgicos mediante el empleo del agente remediante.

a. *Diagramas de Simulación de la Influencia de las variables de operación que influyen en el tratamiento de remediación de efluentes metalúrgicos mediante el empleo del agente remediante.*

A continuación, se presentan cada uno de los diagramas de simulación de la influencia de las variables de operación tales como: tamaño de partícula, temperatura de síntesis del agente remediante, concentración de cobre, relación: sólido/líquido, RPM (velocidad de agitación de la mezcla).

b. *Diagrama de Simulación de Tratamiento de Remediación de efluentes metalúrgicos con agente remediante, teniendo en cuenta la contribución de la variable de operación del tamaño de partícula*

El Diagrama de Simulación de la Influencia de la variable de operación del tamaño de partícula del agente remediante en el tratamiento de remediación de efluentes metalúrgicos, permite que se realice la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

Cabe resaltar que las Variables de Operación que se empleo destaca:

- Tiempo de Agitación de la Mezcla: 0-1000 minutos
- RPM: 200
- S/L: 0.02
- $[Cu^{+2}]$: 1.5 gr/Lt
- Temperatura de síntesis de agente remediante: $400^{o}C$.
- Tamaño de Partícula: 15 μ, 20 μ, 25 μ, 30 μ, 40 μ, 60μ

Por lo tanto, la Variable de Operación sometido a evaluación será el Tamaño de Partícula del agente remediante; a partir del cual, se deduce, que, a menor tamaño de partícula, el tamaño de abertura de 15 μ, se presenta una mayor cinética de remediación del efluente metalúrgico con el agente remediante.

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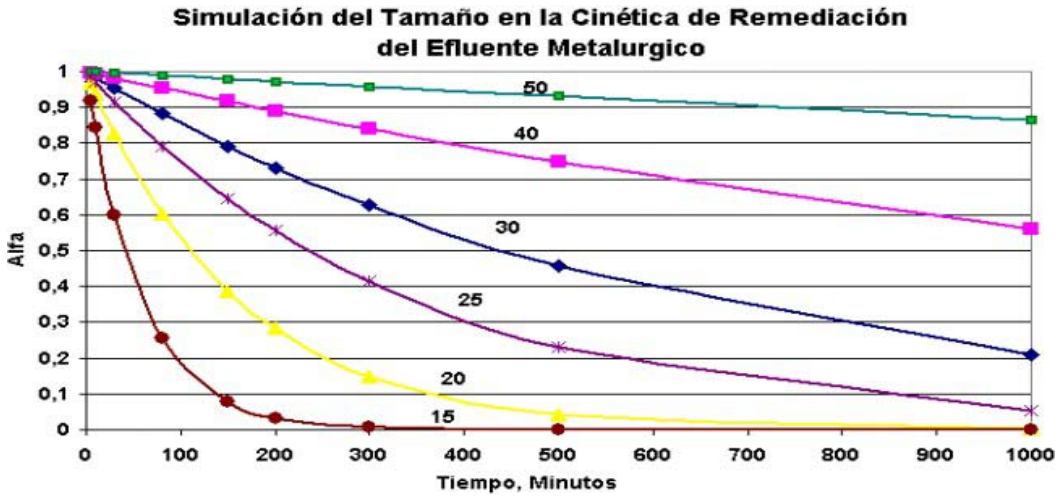

Figura 4: Diagrama de simulación de tratamiento de remediación de efluentes metalúrgicos con el agente remediante teniendo en cuenta la contribución de la variable de operación del tamaño de partícula

c. *Diagramas de Simulación de la Influencia de la variable de operación de temperatura de síntesis del agente remediante en el tratamiento de remediación de efluentes metalúrgicos.*

El Diagrama de Simulación de la Influencia de la variable de operación de la temperatura de síntesis del agente remediante en el tratamiento de remediación de efluentes metalúrgicos, lo cual permite que se realice la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

En la Figura 6, se empleo la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

Cabe resaltar que las Variables de Operación que se emplearon tenemos:

- Tamaño de Partícula: 54 μ
- Tiempo de Agitación de la Mezcla: 0-1000 minutos
- S/L: 0.02
- $[Cu^{+2}]$: 0,7 gr/Lt.
- RPM: 525
- Temperatura de síntesis del agente remediante: 400°C, 600°C, 800°C,1000°C, 1200°C

Por lo tanto, la Variable de Operación sometido a evaluación será la temperatura de síntesis del agente remediante; a partir del cual, se deduce, que, a menor temperatura de síntesis, se presenta una mayor cinética de remediación del efluente metalúrgico con el agente remediante.

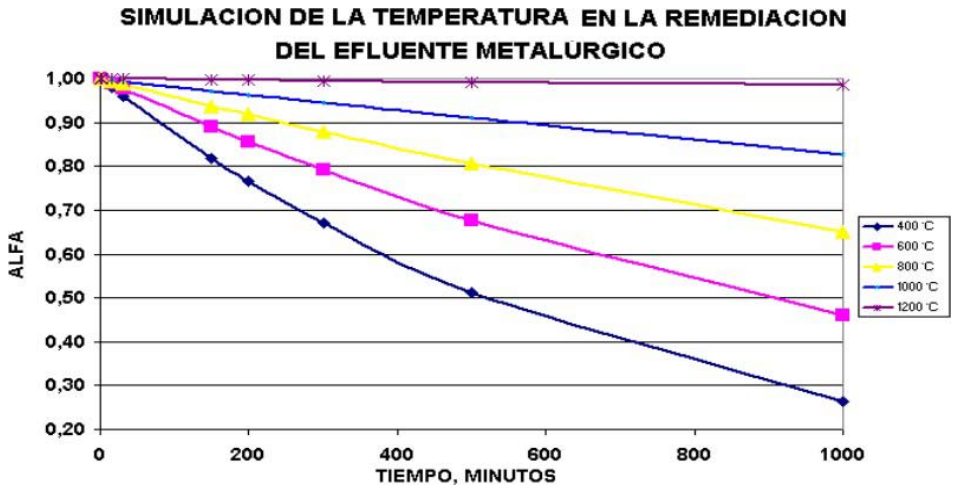

Figura 5: Diagrama de Simulación de Tratamiento de remediación de efluentes metalúrgicos con agente remediante teniendo en cuenta la contribución de la variable de operación de la temperatura de síntesis del agente remediante

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d. Diagramas de Simulación de la influencia de la variable de operación de concentración de cobre disuelto presente en el tratamiento de remediación de efluentes metalúrgicos.

El Diagrama de Simulación de la Influencia de la variable de operación de la concentración de cobre disuelto en el efluente, permite que se realice la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

En la Figura Nº 7, se empleo la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

Cabe resaltar que las Variables de Operación que se emplearon tenemos:

- Tamaño de Partícula: 70 μ
- Tiempo de Agitación de la Mezcla: 0-1000 minutos
- S/L: 0.04
- RPM: 525
- Temperatura de síntesis del agente remediante: 700ºC

Siendo la Variable de Operación a evaluar, la Concentración de Cobre, es decir para evaluar la influencia de la variable de operación del [Cu^{+2}]; a partir de lo cual cuando la [Cu^{+2}] es igual a 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 gr/Lt, se deduce que cuando menor es la concentración de cobre, mayor será la cinética de remediación del efluente metalúrgico con el agente remediante

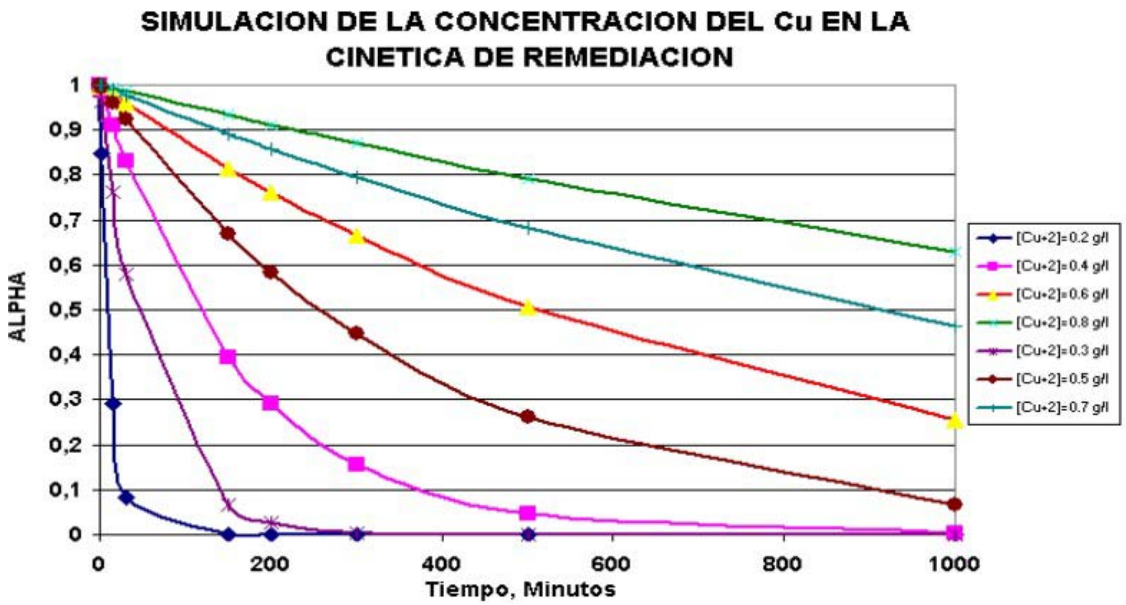

Figura 6: Diagrama de Simulación de tratamiento de remediación de efluentes metalúrgicos con agente remediante teniendo en cuenta la contribución de la variable de operación a la concentración de cobre presente en el efluente metalúrgico

e. Diagramas de Simulación de la influencia de la variable de operación de relación Sólido/Líquido empleado en el tratamiento de remediación de efluentes metalúrgicos.

El Diagrama de Simulación de la Influencia de la variable de operación de la concentración de relación Sólido/Líquido permite que se realice la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

En la Figura 8, se empleo la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

Cabe resaltar que las Variables de Operación que se emplearon tenemos:

- Tamaño de Partícula: 70 μ
- Tiempo de Agitación de la Mezcla: 0-1000 minutos
- [Cu^{+2}]: 0.7 gr/Lt.
- Temperatura de síntesis del agente remediante: 700ºC
- RPM: 50
- S/L: 0.01, 0.02, 0.03, 0.04

Siendo la Variable de Operación: la relación Sólido-Líquido, sometida a evaluación en el tratamiento

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de remediación de efluentes metalúrgicos, cuyos valores son iguales a 0.01, 0.02, 0.03, 0.04; a partir de lo cual se deduce que a menor valor de la proporción de la Relación Sólido/Líquido, se presenta mayor cinética de remediación del efluente metalúrgico con el agente remediante.

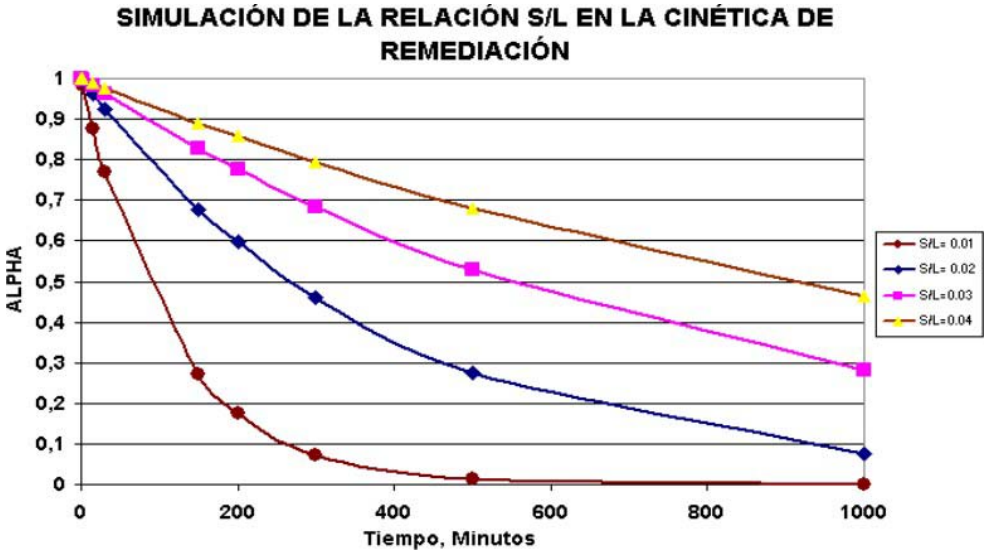

Figura 7: Diagrama de Simulación de tratamiento de remediación de efluentes metalúrgicos con agente remediante teniendo en cuenta la contribución de la variable de operación de la relación sólido/líquido

f. Diagramas de Simulación de la influencia de la variable de operación de velocidad de agitación de la mezcla (RPM) empleado en el tratamiento de remediación de efluentes metalúrgicos.

El Diagrama de Simulación de la Influencia de la variable de operación de la concentración de relación Sólido/Líquido permite que se realice la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

En la Figura 10, se empleo la Simulación de los Datos Experimentales de las Variables de Operación que intervienen en el Cinética Química del Tratamiento de Remediación de Efluentes Metalúrgicos de Flotación de Minerales Sulfurados de Cobre y la Lixiviación de Minerales Oxidados de Cobre.

Cabe resaltar que las Variables de Operación que se emplearon tenemos:

- Tamaño de Partícula: 70 μ
- Tiempo de Agitación de la Mezcla: 0-1000 minutos
- S/L: 0.02
- $[Cu^{+2}]$: 0.7 gr/Lt.
- Temperatura de síntesis del agente remediante: 400°C
- RPM: 50, 100, 200, 300, 400, 500, 600

Siendo la Variable de Operación para evaluar, la Velocidad de Agitación del agente remediante. Se observa que a menor velocidad de agitación de la mezcla (RPM), se presenta mayor cinética de remediación del efluente metalúrgico con el agente remediante.

IV. Conclusiones

- Los Tratamientos de Remediación de los efluentes metalúrgicos están basados en procesos activos que son de naturaleza química, donde el costo lo asume la empresa generadora de este tipo de impacto en el medio ambiente. Es por ello, que se hace necesario buscar una alternativa al Tratamiento de la acidez de efluentes metalúrgicos provenientes de Tratamientos de Flotación de Minerales Polimetálicos Sulfurados y Efluentes de Soluciones de Sulfato de Cobre provenientes de Tratamientos Hidrometalúrgicos de la Industria del Cobre, tanto si las instalaciones se encuentran en operación ó en abandono, mediante sistemas de bajo costo y de fácil operación y mantenimiento.
- Las Pruebas experimentales del Tratamiento de Remediación de efluentes metalúrgicos se basaron en el fundamento de la cinética de reacción de primer orden de regresión polinómica, empleando el agente remediante natural y comercial sin tratar y tratados.
- El articulo permite la predicción de la reducción de la concentración de metales pesados, especialmente el cobre en tiempo real; específicamente, la reducción de la concentración de ión disuelto de cobre proviente de Procesos Metalúrgicos de la Flotación de Minerales y de la Hidrometalurgia.
- La Simulación Computacional de la remediación de efluentes metalurgicos de lixiviación y flotación

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de minerales sulfurados polimetálicos generados a escala de laboratorio y a nivel piloto para reducir la concentración de metal pesado de cobre permite sistematizar cada una de las contribuciones de las variables independientes de operación que influencian en la cinética de remediación del cobre tales como: concentración de ión cobre (**K(Cu^{+2});** relación sólido/líquido (**K(S/L)**; tamaño de partícula de agente remediante **K(Tamaño de Partícula)**; rpm **K(RPM)**; temperatura de descomposición térmica de agente remediante (**K T)** y el tiempo de agitación de la mezcla durante el tratamiento de remediación de los efluentes metalúrgicos de flotación y de lixiviación de minerales sulfurados y oxidados de cobre respectivamente.

- La Ecuación General que sistematiza la influencia de cada una de las variables de operación que intervienen en el Tratamiento de Remediación de los Efluentes Metalúrgicos de Flotación y de Lixiviación de Minerales Sulfurados y Oxidados de Cobre respectivamente, está dada por la siguiente ecuación General: **Ln α = K t.**
- Una forma de Sistematizar la influencia de cada una de las variables que intervienen en el Tratamiento de Remediación es a través de una Ecuación General que represente un Modelo Matemático, el cual será:

$$K = [K_{(\text{Tamaño de Partícula})} * K\,T * K\,(Cu^{+2}) * K_{(S/L)} * K_{(RPM)}]$$

$$\text{Ln}\,\alpha = 19.53358078 * (d)^{-3,4465} * (RPM)^{-1,0116} * (S/L)^{-1,7549} * (Cu^{+2})^{-3,7345} *$$

$$[8.154997255 - (\underline{12178,28697})] * t$$
$$(T+273.1)$$

Donde:

K_T: Constante de Remediación General;

$K_T = 4 \times 10\text{-}28\ (T)^{8,9136}$

$K_{tamaño}$: Constante de Tamaño de partícula de agente remediante

$K_{Tamaño} = 41536\ X^{-3.4465}$

K (Cu^{+2}) : Constante de Concentración de ión Cobre presente en el efluente metalúrgico a tratar;

K (Cu^{+2}) = 0,9923 (Cu^{+2}) $^{-3,7345}$

K (S/L): Constante de relación Sólido-Líquido empleado en el tratamiento de remediación;

K (S/L) = $1x10^{-5}$ $(S/L)^{-1.7549}$

K (RPM): Constante de Velocidad de Agitación de la mezcla, revoluciones por minuto. K RPM = 47.393 $(RPM)^{-1.0116}$

- Se ha considerado que el proyecto garantiza la sostenibilidad dado que posee dimensiones de innovación tecnológica, ambiental, económica y social.

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Geological Characterization, Mapping and Sampling of the Tailing Pond from Cerro El Toro, Region La Libertad-Perú

By Mg. Ing. Silvana L. Flores Chávez, Bach. Edison Gastulo Zegarra Luna, Mg. Laura Barrionuevo Torres, Dr. Jorge Alberto Del Carpio Salinas & Dra. Dominga Micaela Cano Ccoa
Universidad Nacional Mayor de San Marcos

Abstract- The present article shows the working methodology of the project field: "Development and validation of a clean technology for the integral treatment of neutralization of effluents and metallurgical tailings in the use of calcareous agents". 1. Geological Characterization, 2. Delimitation of the area of environmental influence for legal exploitation, 3. Mapping, 4. Sampling, 5. Calculation of the volume of tailings, 6. Study of the environmental impact of legal exploitation relationships. It should be noted each one of these activities are important as part of the methodology of work in field, which one are developed in the tailing: “Cerro El Toro” which has been divided the aforementioned relationship into 73 sampling points, grouped according to the relationships: Salinas 1, Salinas 2, Salinas 3, Montoro and Melva, whose volume has been determined through the software AutoCAD Civil which has determined that tailings have the following volume: Salinas 1: 1917.5 m3, Salinas 2 : 20331.48 m3, Salinas 3 : 18375 m3 , Montoro: 668.56 m3 y Melva: 27945,5 m3; whose volume allowed the obtention of a representative sample of the tailing for been studied of their “Environmental Quality of tailing” which gives through the geochemical characterization analysis with the purpose of determining the “Real Impact” of the pollution of tailing in the mining communities of Shiracmaca and Coigobamba.

Keywords: geological characterization, mapping, sampling, tailing pond, cyanidation tail, cerro el toro.

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Geological Characterization, Mapping and Sampling of the Tailing Pond from Cerro El Toro, Region La Libertad-Perú

Caracterización Geológica, Mapeo Y Muestreo De La Relavera De Cerro El Toro, Región La Libertad-Perú

Mg. Ing. Silvana L. Flores Chávez [α], Bach. Edison Gastulo Zegarra Luna [σ], Mg. Laura Barrionuevo Torres [ρ], Dr. Jorge Alberto Del Carpio Salinas [ω] & Dra. Dominga Micaela Cano Ccoa[¥]

Resumen- El presente artículo muestra la metodología de trabajo de campo del proyecto: *"Desarrollo y validación de una tecnología limpia para el tratamiento integral de neutralización de efluentes y relaves metalúrgicos basados en el empleo de agentes calcáreos"* que se caracteriza por comprender las siguientes actividades:

1. Caracterización Geológica
2. Delimitación del área de influencia ambiental para la explotación legal
3. Mapeo,
4. Muestreo,
5. Cálculo del volumen de relaves,
6. Estudio del Impacto Ambiental de las relaveras de explotación legal.

Cabe resaltar, que cada una de dichas actividades son importantes como parte de la Metodología del trabajo en campo, todas ellas trabajadas en la relavera "Cerro El Toro", que dividió la relavera mencionada en 73 puntos de muestreo, agrupados según las relaveras: Salinas 1, Salinas 2, Salinas 3, Montoro y Melva cuyo volumen se determinó mediante el software AutoCAD civil, que determinó que las relaveras poseen los siguientes volúmenes: Salinas 1: 1917.5 m^3, Salinas 2: 20331.48 m^3, Salinas 3: 18375 m^3 , Montoro: 668.56 m^3 y Melva: 27945,5 m^3; cuyos volúmenes permiten la obtención de una muestra representativa de las relaveras para ser sometida al estudio de su "Calidad Ambiental del relave", lo cual se da a través del análisis de caracterización geoquímica, con el objeto de determinar el "Impacto Real" de la contaminación de las relaveras en las comunidades mineras de Shiracmaca y Coigobamba.

Palabras clave: caracterización geológica, mapeo, muestreo, relavera, relave de cianuración, cerro el toro.

Abstract- The present article shows the working methodology of the project field: "Development and validation of a clean technology for the integral treatment of neutralization of effluents and metallurgical tailings in the use of calcareous agents".

1. Geological Characterization,
2. Delimitation of the area of environmental influence for legal exploitation,
3. Mapping,
4. Sampling,
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6. Study of the environmental impact of legal exploitation relationships.

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Keywords: geological characterization, mapping, sampling, tailing pond, cyanidation tail, cerro el toro.

I. Introducción

El Estudio: Caracterización Geológica, mapeo y muestreo de la relavera de Cerro El Toro, Región La Libertad" se basa en un estudio inicial perteneciente al Hito 1, referente al Informe Técnico de Caracterización Fisicoquímica del relave y efluentes metalúrgicos del Proyecto: "Desarrollo y Validación de Tecnología Limpia para el Tratamiento Integral de Neutralización de efluentes y relaves metalúrgicos basados en el empleo de agentes calcáreos", el cual fue un Proyecto que concurso a nivel nacional por la Empresa: Green Metallurgy Technologies S.R.L, en el rubro de Proyecto de Innovación Productiva del Fondo

Author α ρ: Estudiante de Doctorado en Ciencias Ambientales de la Universidad Nacional Mayor de San Marcos.
e-mails: silvana.flores1@unmsm.edu.pe, laura_cbt@hotmail.com
Author σ: Investigador Científico, Green Metallurgy Technologies S.R.L.
e-mail: procesosgeometalurgicos@hotmail.com
Author ω: Docente Universitario, Universidad Peruana de Ciencias y Humanidades. e-mail: Jorgedelcarpio.concytec@gmail.com
Author ¥: Docente Universitario de la Universidad Nacional de Juliaca.
e-mail: micaelaccoa@hotmail.com

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FIDECOM que pertenece al Programa de Ciencia y Tecnología – FINCyT, el cual fue un Proyecto Ganador a Nivel Nacional que fue financiado por el Programa Nacional de Innovación para la Competitividad y Productividad-PNCIP del Ministerio de Producción, en mérito a su Impacto Ambiental y al Carácter de Innovación Productivo que planteaba la implementación de dicho proyecto. Asimismo, cabe resaltar, que dicho Proyecto recibió la Asesoría Técnica del Staff de Ingenieros de la referida Empresa Peruana de Base Tecnológica bajo la modalidad de Auspicio y Patrocinio, puesto que la Empresa Consultora de Proyectos Geológico-Minero-Metalúrgicos-Ambientales de Impacto Social se dedicada a la exploración, explotación y beneficio de minerales, relaves por procesos de Concentración Gravimétrica, Cianuración, Flotación para minerales oxidados y sulfurados, respectivamente con un enfoque de Innovaciones Tecnológicas para la producción limpia de minerales y relaves valiosos.

II. Justificaciòn

El estudio constituirá una valiosa herramienta de aporte para el establecimiento de la Línea Base de la Evaluación Preliminar de la contaminación de la relavera de Cerro El Toro dentro del Marco de un Plan de Descontaminación de Suelos, conforme lo establece el Decreto Supremo N° 002-2013-MINAM, puesto que las actividades tales como: caracterización geológica, mapeo y muestreo, son actividades complementarias y simultáneas que permitirán determinar la calidad ambiental del área de influencia del proyecto, que puede ser de dos tipos: área de influencia directa y el área de influencia indirecta tanto en el ámbito ambiental como social.

En ese sentido, el Área de Influencia de un Proyecto, se entiende como la porción del territorio donde se realizará la construcción, operación y posterior cierre del proyecto, se considera también el área alrededor del cual podrá haber algún tipo de impacto.

Por su parte, el Área de Influencia Directa (AID) está definido por la ocurrencia de impactos significativos (normalmente asociados a los impactos directos), ya sean negativos o positivos. Incluye aquellas áreas donde se llevarán a cabo las operaciones unitarias principales y auxiliares inherentes al proyecto, así como de los sistemas de infraestructura, equipamiento, actividades y servicios que se instalarán de manera permanente o temporal, representando un potencial impacto sobre el hábitat natural, estas áreas se caracterizan por:

- Una intervención efectiva en función de la dinámica natural del proyecto sobre los hábitats y ecosistema.
- Restricción de uso u ocupación de suelos y
- Afectación de la dinámica poblacional

Estas características estarán delimitadas por factores ambientales representativos como: hidrológico, la predominancia del viento en el ámbito local (dirección) y fisiográfico o relieve del lugar a desarrollar el proyecto. La extensión del AID del proyecto es de 10 Hectáreas, como se muestra en la tabla 1.

Tabla 1: Área de Influencia Directa del Proyecto

Área de Influencia	Región	Provincia	Distrito	Centros Poblados/Caserío
Área de Influencia Directa (AID)	La Libertad	Sánchez Carrión	Huamachuco	Centro Poblado Shiracmaca
				Caserío El Toro
				Caserío de Coigobamba
				Anexo de Santa Cruz

Fuente: Elaboración propia

Por otra parte, el Área de Influencia Indirecta (AII) del proyecto comprende las delimitaciones geográficas, tales como: cuencas o sub cuencas y/o las delimitaciones político-administrativo.

En un primer análisis, se consideran las áreas con definición política administrativa tales como: Centros Poblados y Actividades Económicas Productivas, articulación vial directa entre otros, como se en detalle en la tabla 2.

Tabla 2: Área de Influencia Indirecta del Proyecto

Área de Influencia	Región	Provincia	Distrito	Centros Poblados/Caserío
Área de Influencia Indirecta (AII)	La Libertad	Sánchez Carrión	Huamachuco	Huamachuco Pueblo

Fuente: Elaboración propia

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III. Materiales y Métodos

La Metodología del estudio se caracteriza por ser con un enfoque cuantitativo de tipo descriptiva que involucra la realización de las actividades de la Caracterización Geológica, Mapeo y Muestreo de la relavera de "Cerro El Toro" del Distrito de Huamachuco, Provincia de Sánchez Carrión, Región La Libertad-Perú causada por la generación de relaves de cianuración que son depositados en la relavera en mención.

Cabe resaltar, que la metodología también se baso en la Metodología empleada por la *"GUÍA PARA LA ELABORACIÓN DE PLANES DE DESCONTAMINACIÓN DE SUELOS"* en el Marco del Decreto Supremo Nº 002-2013-MINAM, que aprueba los Estándares de Calidad Ambiental (ECA) para Suelo que fue elaborado por la Dirección General de Calidad Ambiental del Vice Ministerio de Gestión Ambiental del Ministerio del Ambiente, puesto que se considero que la Información de la Calidad Ambiental del Suelo afectado por los relaves metalúrgicos de cianuración de las relaveras de *"Cerro El Toro"* constituye una línea base para la elaboración de un Plan de Descontaminación de Suelos, que se deriva en general de la evidencia que los relaves son fuente potencial de contaminación de suelo, cuyos valores de parámetros inorgánicos, supera los ECA para suelo, conforme lo establece el Decreto Supremo Nº 002-2013-MINAM; siendo necesario para determinar esta condición el desarrollo de la evaluación preliminar del sitio y del muestro de identificación en las áreas de potencial interés, tal como la relavera mencionada. En relación a ello, la Metodología planteada por un Plan de Descontaminación de Suelos según el MINAM, se basa en reducir la concentración de los valores de los Parámetros Inorgánicos de los ECA para suelo, para la actividad de beneficio minero-metalúrgico aurífera informal que genera riesgos de contaminación del suelo en su emplazamiento y áreas de influencia que posee 3 fases claramente diferenciadas según sus objetivos, los cuales son: a) Fase de identificación (Previo a la elaboración del PDS), b) Fase de caracterización (Elaboración del PDS) y c) Fase de remediación (Posterior al PDS).

a) *Actividades de la Metodología de la Caracterización geológica, Mapeo y Muestreo de la relavera de Cerro El Toro*

Considerando la Metodología del Plan de Descontaminación de Suelos según el MINAM, la Metodología de la "Caracterización Geológica, Mapeo y Muestreo de la relavera de Cerro El Toro" involucra las siguientes actividades:

- Caracterización Geológica.
- Delimitación del Área de Influencia Ambiental de las relaveras de explotación Legal de la relavera.
- Mapeo de las relaveras de explotación legal de la relavera.
- Muestreo de las relaveras de explotación legal de la relavera.
- Cálculo del volumen de relaves de la relavera.
- Estudio del Impacto Ambiental de las relaveras de Explotación Legal de la relavera.

A continuación se detallan cada una de las actividades mencionadas anteriormente:

i. *Caracterización Geológica de la relavera de "Cerro El Toro"*

La zona de interés se ubica en el cerro el Toro, distrito de Huamachuco, Provincia de Sánchez Carrión, en el departamento de La Libertad, geográficamente la zona del proyecto pertenece a la flanco oriental de la Cordillera Occidental.

El acceso a la zona de estudio desde la ciudad de Trujillo, capital del departamento de La Libertad, se realiza por vía terrestre a través de la ruta Trujillo – Shiran – Dv. Otuzco – Shorey – Quiruvilca – Huamachuco, recorriendo una longitud de 181 km de carretera asfaltada, una vez en Huamachuco se realiza un recorrido de 2.8 km de carretera afirmada hasta la zona de estudio.

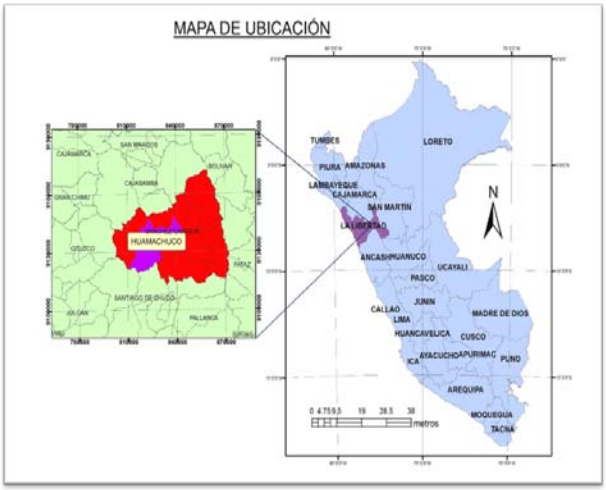

Fig. 1: Mapa de ubicación de la zona de estudio



Fig. 2: Mapa de acceso a cerro el Toro

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a. *Geología Local*

La Geomorfología y la Litoestratigrafia permiten determinar el área afloran unidades lito-estratigráficas sedimentarias que comprenden edades desde el Jurásico Superior (Fm. Chicama) y Cretáceo inferior (Grupo Goyllarisquizga) hasta los depósitos Cuaternarios recientes.

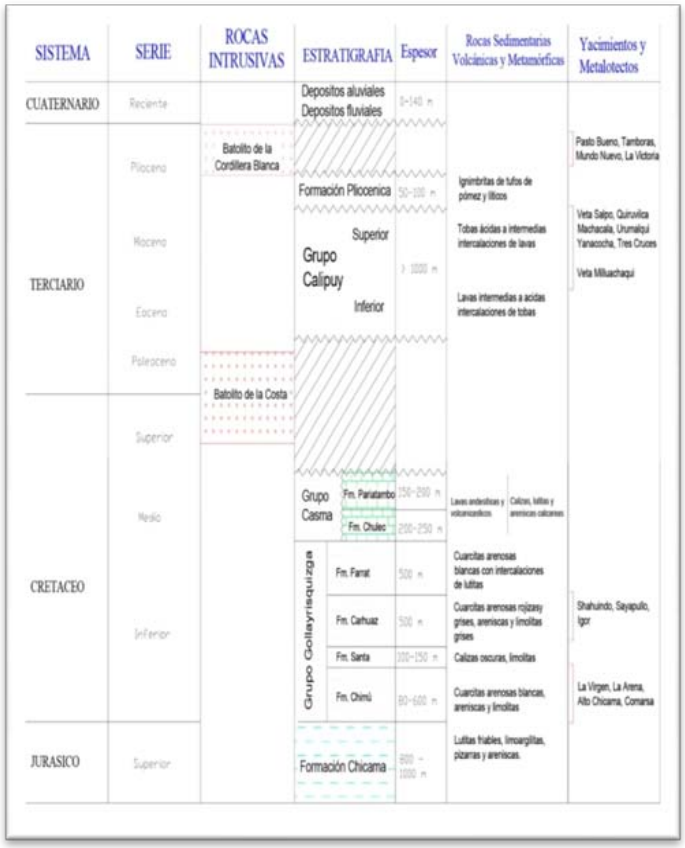

Fig. 3: Columna estratigráfica de la zona de estudio

ii. *Delimitación del área de Influencia Ambiental de las relaveras de explotación legal de la relavera "Cerro El Toro"*

La delimitación del área de influencia ambiental de las relaveras de explotación legal de la relavera "Cerro El Toro" involucra a su vez las actividades de reconocimiento y localización de las relaveras legales de la relavera de "Cerro El Toro".

En ese sentido, se delimito las zonas de mayor interés para evaluar, analizar su potencial para el desarrollo del proyecto. Se llegó a reconocer 5 zonas potenciales, de las cuales 3 de ellas destacan por su mayor volumen e impacto ambiental las cuales son: - Salinas 1, - Salinas 2 (Mayor potencial volumétrico), - Salinas 3 (mayor potencial volumétrico), - Montoro y - Melva 20 (mayor potencial volumétrico). Ver Figura 4.

iii. *Mapeo de las relaveras*

En el mapeo de las relaveras se tomó en cuenta el contenido de mineralógico (óxidos, sulfuros,) y las tonalidades del material que contenían. Ver Figuras 5 y 6.

A continuación, se citan las principales relaveras que pertenecen a "Cerro El Toro":

- ✓ Salinas 1: Se reconoce la presencia de sulfuros (pirita, calcopirita) con poca presencia de óxidos, cuenta con una granulometría fina a media con un buen porcentaje de arcillas.
- ✓ Salinas 2: Presenta una tonalidad pardo ocre claro, por la presencia de óxidos e hidróxidos de hierro (limonitas y hematitas), a su vez también presenta una zonza más blanquecinas con un 40% de arcillas. En esta zona se encuentra con una granulometría de material fino que va desde 0.032 mm hasta bolones de 5 cm de diámetro
- ✓ Salinas 3: Se caracteriza por tener coloraciones pardas amarillentas con partes blanquecinas y una granulometría mayor que salinas 2 que va desde 0.032 mm hasta boloneria de 15 cm, 20cm, 30 cm de diámetro.
- ✓ Montoro: Claramente tiene un color pardo ocre oscuros con presencia de óxidos, y una granulometría más uniforme con un promedio de 0.2 mm de diámetro.
- ✓ Melva 20: Posee con una granulometría uniforme, con un 45-50 % de arcillas en su composición y es de un gris claro, son sectores pardos amarillentos.

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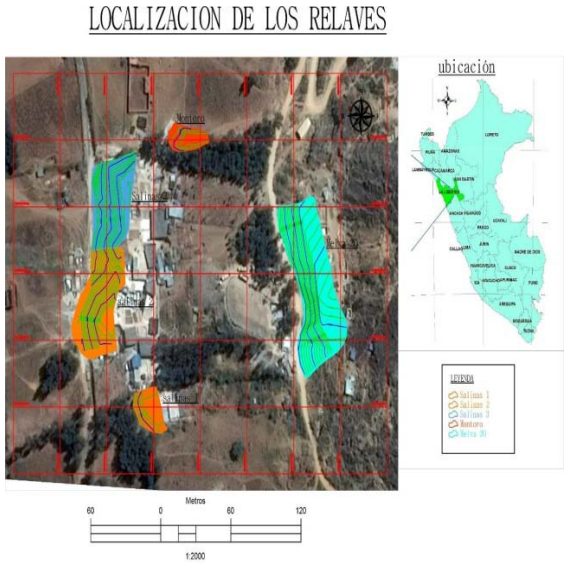

Fig. 4: Vista aérea de la zona de estudio

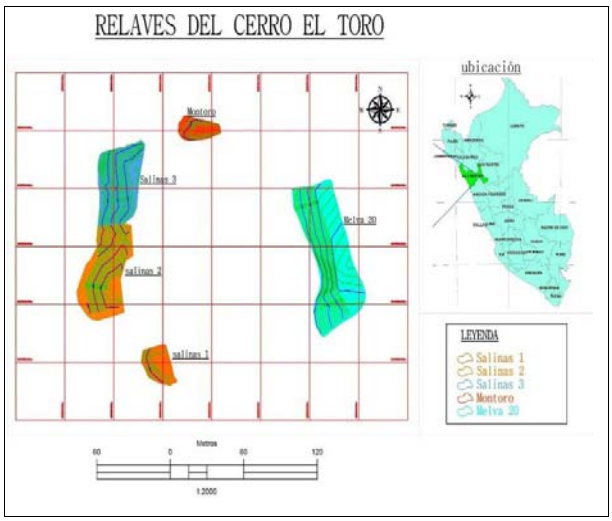

Fig. 5: Mapa de las relaveras a estudiar la identificación de las relaveras según Mallado geoquímico

iv. *Muestreo de las relaveras de explotación legal de la relavera "Cerro El Toro"*

Este método consiste en ubicar las muestras en un patrón regular en toda la zona de estudio; puede utilizarse a partir de un punto determinado al azar, a partir del cual se establece cierta distancia para ubicar los demás puntos (distancias uniformes entre sí). Este tipo de muestreo se realiza después de realizar la rejilla rectangular o polar de la relavera.

a. *Actividades del Muestreo*

Entre las actividades destacan:

- Localización Puntual de las relaveras de "Cerro El Toro": "Salinas 1", "Salinas 2", "Salinas 3", "Montoro" y "Melva 20".
- Delimitación de las áreas del muestreo de relaveras.
- Planteamiento del Tipo de Muestreo.
- Localización, Distribución y Número de Puntos de Muestreo.

A continuación, se detallan cada una de sus actividades:

b. *Localización Puntual de las relaveras de "Cerro El Toro"*

El muestreo se llevó acabó en la comunidad de Sausacocha, distrito de Huamachuco, ubicado con coordenadas UTM DATUM WGS84 tal como indica la siguiente imagen Satelital. Ver Figura Nº 6.

c. *Delimitación de las Áreas de Muestreo*

Se tomó como base la información que se conocía de la mala práctica del tratamiento de relaves en la zona por los mismos vecinos del lugar, del cual se tomó en consideración 3 relaveras que contienen mayor cantidad de material e impacto ambiental es mayor (Salinas, Montoro, Melva 20). Ver Figura Nº 7.



Fig. 6: Localización Geográfica de relaveras de Cerro El Toro de Huamachuco



Fig. 7: Delimitación de las áreas de muestreo de las relaveras de Cerro El Toro de Huamachuco

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d. *Muestreo Sistemático*

Este método consiste en ubicar las muestras en un patrón regular en toda la zona de estudio; puede utilizarse a partir de un punto determinado al azar, a partir del cual se establece cierta distancia para ubicar los demás puntos (distancias uniformes entre sí). Este tipo de muestreo se realiza después de realizar la rejilla rectangular o polar de la relavera.

e. *Localización, Distribución y Número de puntos de muestreo*

Con el muestreo sistemático en forma de rejilla polar, con una distancia de separación de cada muestra de 10 metros a los largo de toda la superficie de estudio, se recolectaron 73 muestras en los distintos relaves (Salinas, Montoro, Melva 20). Ver Figuras 8, 9, 10, 11, 12 y 13 y Tabla 3.



Fig. 8: Localización, Distribución y Número de Puntos de Muestreo de las relaveras de Cerro El Toro

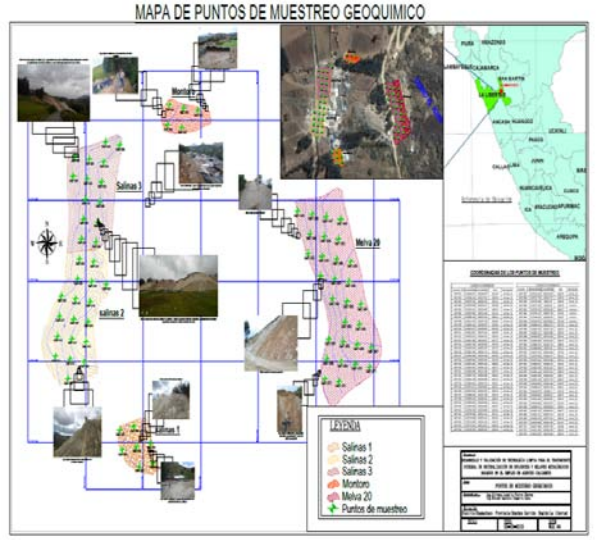

Fig. 9: Mapa de Puntos de Muestreo Geoquímico de las relaveras



Fig. 10, 11, 12 y 13: Ing. Zegarra realizando la identificación, delimitación y Muestreo sistemático de muestras de relave

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Tabla 3: Coordenadas UTM de los puntos de muestreo de la relavera de "Cerro El Toro"

CUADRO DE COORDENADAS				
Muestra ID	Norte(WGS84)	Este(WGS84)	Cota	Descripción
GMT-001	9133569.873	829246.879	3251.94	salinas_01
GMT-002	9133568.156	829237.027	3250.09	salinas_01
GMT-003	9133579.724	829245.162	3252.23	salinas_01
GMT-004	9133578.008	829235.311	3252.88	salinas_01
GMT-005	9133576.291	829225.459	3248.67	salinas_01
GMT-006	9133587.859	829233.594	3251.5	salinas_01
GMT-007	9133586.142	829223.742	3248.23	salinas_01
GMT-008	9133611.57	829187.708	3248.96	salinas_02
GMT-009	9133620.123	829198.97	3255.85	salinas_02
GMT-010	9133621.477	829189.063	3252.62	salinas_02
GMT-011	9133622.832	829179.155	3245.49	salinas_02
GMT-012	9133630.031	829200.325	3258.43	salinas_02
GMT-013	9133631.385	829190.417	3255.75	salinas_02
GMT-014	9133632.74	829180.509	3247.69	salinas_02
GMT-015	9133639.939	829201.679	3257.73	salinas_02
GMT-016	9133641.293	829191.771	3252.83	salinas_02
GMT-017	9133642.648	829181.864	3245.99	salinas_02
GMT-018	9133649.846	829203.056	3252.9	salinas_02
GMT-019	9133651.201	829193.126	3248.42	salinas_02
GMT-020	9133652.555	829183.218	3243.73	salinas_02
GMT-021	9133658.4	829214.296	3247.93	salinas_02
GMT-022	9133659.754	829204.388	3249.41	salinas_02
GMT-023	9133661.109	829194.48	3243.25	salinas_02
GMT-024	9133669.662	829205.743	3248.22	salinas_02
GMT-025	9133671.017	829195.835	3242.31	salinas_02
GMT-026	9133679.57	829207.097	3250.1	salinas_02
GMT-027	9133680.924	829197.189	3243.76	salinas_02
GMT-028	9133689.478	829208.452	3248.01	salinas_02
GMT-029	9133690.832	829198.544	3242.11	salinas_02
GMT-030	9133699.386	829209.806	3249.47	salinas_02
GMT-031	9133700.74	829199.898	3243.81	salinas_02
GMT-032	9133709.294	829211.161	3251.31	salinas_02
GMT-033	9133710.648	829201.253	3244.35	salinas_02
GMT-034	9133712.002	829191.345	3236.73	salinas_02
GMT-035	9133719.201	829212.515	3250.5	salinas_02
GMT-036	9133720.556	829202.607	3245.64	salinas_02
GMT-041	9133747.41	829258.185	3248.37	montoro
GMT-042	9133736.147	829266.738	3252.4	montoro
GMT-043	9133746.055	829268.093	3250.92	montoro

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Tabla 3: Coordenadas UTM de los puntos de muestreo de la relavera de "Cerro El Toro" (Continuación)

CUADRO DE COORDENADAS				
muestra ID	Norte(WGS84)	Este(WGS84)	Cota	Descripción
GMT-044	9133744.701	829278.001	3251.440	Montoro
GMT-045	9133694.931	829347.271	3275.780	melva_20
GMT-046	9133693.576	829357.178	3283.59	melva_20
GMT-047	9133692.222	829367.086	3290.93	melva_20
GMT-048	9133690.867	829376.994	3292.19	melva_20
GMT-049	9133683.669	829355.824	3280.78	melva_20
GMT-050	9133682.314	829365.732	3288.09	melva_20
GMT-051	9133680.960	829375.64	3293.12	melva_20
GMT-052	9133673.761	829354.469	3277.64	melva_20
GMT-053	9133672.406	829364.377	3285.25	melva_20
GMT-054	9133671.052	829374.285	3293.22	melva_20
GMT-055	9133669.697	829384.193	3295.42	melva_20
GMT-056	9133662.498	829363.023	3280.75	melva_20
GMT-057	9133661.144	829372.931	3289.53	melva_20
GMT-058	9133659.789	829382.839	3296.11	melva_20
GMT-059	9133651.236	829371.576	3286.67	melva_20
GMT-060	9133649.882	829381.484	3296.70	melva_20
GMT-061	9133648.527	829391.392	3298.12	melva_20
GMT-062	9133639.974	829380.13	3293.39	melva_20
GMT-063	9133638.619	829390.037	3296.75	melva_20
GMT-064	9133631.42	829368.867	3280.87	melva_20
GMT-065	9133630.066	829378.775	3291.5	melva_20
GMT-066	9133628.711	829388.683	3294.91	melva_20
GMT-067	9133627.357	829398.591	3294.77	melva_20
GMT-068	9133621.512	829367.513	3281.59	melva_20
GMT-069	9133620.158	829377.421	3286.78	melva_20
GMT-070	9133618.804	829387.328	3291.97	melva_20
GMT-071	9133617.449	829397.236	3293.6	melva_20
GMT-072	9133611.605	829366.158	3280.7	melva_20
GMT-073	9133610.25	829376.066	3285.07	melva_20

f. *Calculo de volumen de relaves*

En base a la toma de datos en campo (coordenadas UTM, cotas) con la ayuda del software AutoCAD civil 3D se estimó la cantidad de relave potencial para su respectivo tratamiento.

- ✓ Salinas 1: 1917.5 m^3
- ✓ Salinas 2 : 20331.48 m^3
- ✓ Salinas3 : 18375 m^3
- ✓ Montoro : 668.56 m^3
- ✓ Melva : 27945,5 m^3

g. *Estudio del Impacto Ambiental de las relaveras de explotación legal de la relavera "Cerro El Toro"*

No se realiza un adecuado manejo en la acumulación de los relaves, ya que estos no cuentan con un lugar adecuado y no reciben el tratamiento correcto para minimizar la contaminación tanto del acuífero subterráneo como superficial. Asimismo, cabe resaltar, que el impacto ambiental que causa la relavera de Cerro El Toro se ve reflejada en la calidad ambiental del relave de cianuración de la relavera en mención, y

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cuyo impacto se ve reflejado en la contaminación ambiental del suelo, el cual se demuestra por el resultado del ensaye químico de la técnica de caracterización geoquímica por ICP barrido del compósito de la relavera.

h. *Calidad ambiental de relave de cianuración*

Para determinar la calidad ambiental del relave de cianuración se procedió a someterlo al ensaye químico del Análisis Geoquímico por técnica ICP de Barrido de la muestras compósito de la relavera metalúrgica de cianuración de Cerro El Toro por los diferentes relaves de las concesiones de Salinas 1, Salinas 2, Salinas 3, Montoro y Melva, de tal manera que permite determinar el mayor número de elementos químicos que acompañan al relave de cianuración, aparte del oro. Ver Tabla 4.

Tabla 4: Resultado de análisis químico de compósito de relavera de "Cerro El Toro" por técnica ICP de Barrido

CÓDIGO CHP	DESCRIPCIÓN DE LA MUESTRA	ENSAYES QUÍMICOS						
37512	COD. MR-CT1	Ag (ppm)	Al (%)	As (ppm)	Ba (ppm)	Be (ppm)	Bi (ppm)	Ca (%)
		17	0.21	1062	79	2	44	0.79

Tabla 4: Resultado de análisis químico de compósito de relavera de "Cerro El Toro" por técnica ICP de Barrido

CÓDIGO CHP	DESCRIPCIÓN DE LA MUESTRA	ENSAYES QUÍMICOS						
37512	COD. MR-CT1	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (%)	Fe (%)	K (%)	Mg (%)
		< 2	< 1	42	0.01	3.52	0.04	0.04

Tabla 4: Resultado de análisis químico de compósito de relavera de "Cerro El Toro" por técnica ICP de Barrido

CÓDIGO CHP	DESCRIPCIÓN DE LA MUESTRA	ENSAYES QUÍMICOS						
37512	COD. MR-CT1	Mn (%)	Mo (ppm)	Na (%)	Ni (ppm)	P (ppm)	Pb (%)	Sb (ppm)
		0.01	< 5	0.01	3	92	0.01	539

Tabla 4: Resultado de análisis químico de compósito de relavera de "Cerro El Toro" por técnica ICP de Barrido

CÓDIGO CHP	DESCRIPCIÓN DE LA MUESTRA	ENSAYES QUÍMICOS						
37512	COD. MR-CT1	Sc (ppm)	Sn (ppm)	Sr (ppm)	Ti (%)	V (ppm)	W (ppm)	Y (ppm)
		3	< 5	22	< 0.01	5	< 1	1

Tabla 4: Resultado de análisis químico de compósito de relavera de "Cerro El Toro" por técnica ICP de Barrido

CÓDIGO CHP	DESCRIPCIÓN DE LA MUESTRA	ENSAYES QUÍMICOS		
37512	COD. MR-CT1	Zn (%)	Zr (ppm)	Au (Oz/TC)
		< 0.01	3	0.051

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Fig. 14 y 15: Vista de los relaves salinas 2 y 3 y la inadecuada ejecución de su almacenamiento




Fig. 16 y 17: Vista Lateral del proceso de beneficio de minerales auríferos oxidados por el método "VAT LEACHING"

IV. Discusión de Resultados

La discusión de resultados del estudio: Caracterización Geológica, Mapeo y Muestreo de la relavera de Cerro El Toro, región La Libertad-Perú se caracteriza por implementar las siguientes actividades y sub-actividades, cada una de las cuales se encuentran resumidas en la Tabla 5.

Tabla 5: Actividades y Sub-Actividades del Estudio

Actividades	Sub-Actividades
1.- Caracterización Geológica de las Relaveras de Cerro El Toro de Huamachuco	1.1. Determinación de las Generalidades de la Zona de Estudio tales como: Ubicación, Accesibilidad, Clima y Vegetación, Actividades Económicas.
	1.2. Estudio de la Geología Regional y Local del Yacimiento de origen de la relavera de "Cerro El Toro"
2.- Delimitación del Área de Influencia Ambiental de las relaveras de explotación legal de "Cerro El Toro"	2.1. Reconocimiento de las relaveras legales de la relavera de "Cerro El Toro"
	2.2. Localización de las relaveras legales de la relavera de "Cerro El Toro"
3.- Mapeo de las relaveras de explotación legal de "Cerro El Toro"	3.1. Delimitación física y virtual de las relaveras de "Cerro El Toro" para determinar su potencial y volumen de explotación.
	3.2. Análisis de los estudios de la Geología, tales como: Geomorfología, Litoestratigrafía y la Caracterización Mineralógica de los depósitos de mineral antes de ser beneficiados metalúrgicamente y luego convertidos en relaves de "Cerro El Toro"
	3.3. Ubicación Geológica y Determinación de las relaveras: "Salinas 1", "Salinas 2", "Salinas 3", "Montoro" y "Melva 20" que forman parte de la relavera de "Cerro El Toro"

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	3.4. Caracterización por controles litológicos y estructurales de las relaveras de "Cerro El Toro": "Salinas 1", "Salinas 2", "Salinas 3", "Montoro" y "Melva 20"
4.- Muestreo de las relaveras de Explotación Legal de "Cerro El Toro"	4.1. Localización Puntual de las relaveras de "Cerro El Toro": "Salinas 1", "Salinas 2", "Salinas 3", "Montoro" y "Melva 20"
	4.2. Delimitación de las áreas del muestreo de las relaveras.
	4.3. Planteamiento del Tipo de Muestreo
	4.4. Implementación del Muestreo Sistemático
	4.5. Localización, Distribución y Número de Puntos de Muestreo.
5.- Cálculo del Volumen de relaves de "Cerro El Toro"	5.1. Determinación del volumen de los relaves de explotación legal de la relavera de "Cerro El Toro" teniendo en consideración la toma de datos en campo (Coordenadas UTM, cotas) con la ayuda del software AUTOCAD civil 3D se estimó la cantidad de relave potencial para su respectivo tratamiento.
6.- Estudio del Impacto Ambiental de las Relaveras de Explotación de "Cerro El Toro"	6.1. Determinación de la Calidad Ambiental de las relaveras de cianuración: "Salinas 1", "Salinas 2", "Salinas 3", "Montoro" y "Melva 20" de la gran relavera de "Cerro El Toro" que afectan la calidad ambiental del suelo.
	6.2. Caracterización Química Inicial de los relaves metalúrgicos de cianuración de las relaveras: "Salinas 1", "Salinas 2", "Salinas 3", "Montoro" y "Melva 20" de la gran relavera de "Cerro El Toro" por la Técnica ICP de Barrido

Fuente: Elaboración Propia

V. Conclusiones

Es importante realizar la caracterización geológica, mapeo y muestreo de la relavera de cerro el toro del distrito de Huamachuco, provincia de Sánchez Carrión, región La Libertad-Perú, puesto que permite tener una Línea Base de la Calidad Ambiental del suelo según ECA SUELO y la metodología de Plan de Descontaminación del Suelo del MINAM, todo lo cual conllevará a conocer como ocurre la contaminación ambiental química de una relavera principalmente ocurre como la movilización de metales pesados semejante a la alteración o desgaste debido a los procesos atmosféricos de materiales inorgánicos sólidos bajo condiciones exogénicas, principalmente por la interacción de relave con la cuenca de los ríos, establece una interrelación Agua- Sedimento y/o relave, que promueve la contaminación por sólidos y efluentes de las relaveras, todo lo cual a su vez conllevará a emplear la metodología del Plan de Descontaminación de Suelos para promover la remediación de los pasivos ambientales mineros ó mitigar hasta reducir el volumen de las relaveras que conforman la relavera de "Cerro El Toro", puesto que causan la contaminación del suelo y de cuerpos de agua de la cuenca de los ríos aledaños, debido a la existencia de drenaje de la relavera que se determina por la variación de pH de la escorrentía superficial proveniente de éstos relaves, cuyo pH da un valor casi neutro, lo cual no indica que no exista movilidad de los metales pesados en el cuerpo de agua de los ríos.

Por su parte, es importante señalar que se debe caracterizar y establecer procesos capaces de inmovilizar metales pesados de relaves y desechos de mina abandonados, los cuales no sólo dependen de la física y química de los cuerpos hídricos, sino también y principalmente sobre la mineralogía de los cuerpos de la mena y rocas que lo hospedan, de tal manera que los efectos de contaminación son mejor descritos cuando cada elemento tóxico puede ser referido a fases mineralógicas específicas.

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The Trends and Experiences of Sexual and Reproductive Health among Late Female Adolescents in Bangladesh

By Mir Tamanna Siddika
Begum Rokeya University

Abstract- Adolescence period is a very important transitional stage of human develoment as in this period a human being undergoes some major physical, emotional and social changes. Bangladesh has an adolescent population consisting one fifth of the total population. Among them almost half of them are girls. Among the adolescent girls who belong to the late adolescent age group are in the most exposed and disadvantaged situation in the context of Sexual and Reproductive Health (SRH) of Bangladesh. Therefore, the aim of this article is to concentrate on the SRH of adlescents girls (15-19 years) with an aim to reveal the trends and experieces of SRH among this group and some major challenges so that female adolescent SRH issues can receive proper attention in the policy making level.

Keywords: adolescent, sexual and reproductive health, early marriage and pregnancy, contraceptive, violence.

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I. Introduction

Adolescence period is a very vital transitional stage of human develoment. According to the World Health Organization (WHO) those persons between 10 and 19 years of age will be considered as adolescent (WHO, 2014). This phase is depicted by as a period of human growth and development that occurs in between the childhood and adulthood. In this stage a human being experinces some physical, emotional and social changes that necessiate understanding and effective approaches to fulfill the particular needs of adolescents. Physically adolescents go through pubertal changes and changes in brain structure. Psychologically adolescents develop cognitive maturity and critical thiniking skills. They also experience social changes due to the multiple roles they are anticipated to play in the family, community and at school. These alterations occur simultaneously but at a different speed depending on their gender, socio-economic, educational background or other structural and environmental factors (UNICEF, 2011).

As an important development stage of human life, adolescene period is further splited into early adolecesncen (10-14) years and late adolescence (15-19) years. Major physical changes usually occur in late adolescence.[1] In late adolescence girls usually are at greater risk than boys of negative health outcomes because of the gender based discrimination and abuse (UNICEF, 2011). Bangladesh has an adolescent population (those between the ages of 10 and 19 years) of around 29.5 million, more than one fifth of the total population, including 14.4 million girls and 15.1 million boys (Ainul, et al., 2017). Among the 14.4 million girls who are belong the the age group of 15-19, are in the most vulnearble and disadvantaged condition in the context of Sexual and Reproductive Health (SRH). They are the major victim of child marriage, early and risky unwanted sexual activity and pregnency, domestic violence and do not receive rapid care which expose them to adverse health outcomes. Child marriage and adolescent prgnency increase the risk of maternal and child morbidity along with maternal and child mortality. Therefore, this article focuses on the SRH of late female adlescents with an aim to expose the trends and experieces of SRH among this group, available and policy issues and challenges so that some necessary interventions and policies can be taken to enusre necessary services, information, skills for maintaining their healthy and productive lives.

II. Socio-Cultural context of Bangladesh in Relation to Sexual and Reproductive Health

In Bangladesh, as girls reach and progress through adolescence, the gendered norms of their socio-cultural surroundings also begin to play an amplified role in shaping their routes. With the years of late adolescence these social norms begin to become both more severely enforced and more personally prominent. Critically for girls in Bangladesh, the years of adolescence, rather than spreading out their worlds, often perceive them made smaller as girls have to leave comparatively free childhoods and are compelled to accept the gendered adult pathways of their own local environments (Presler-Marshall and Stavropoulou, 2017).

Author: Assistant Professor, Department of Gender and Development Studies, Begum Rokeya University, Rangpur, Bangladesh.
e-mail: tamannamarch20@gmail.com

[1] Most part of this paper was written for summative assessment at London School of Economics

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As Bangladesh is a conservative country, the discussion related to sexuality, fertility and pollution is considered a shameful and a hidden subject. Besides the effect of conservatism and strong patriarchal structures, the country is also influenced by Islam, Hinduism, and traditional religious beliefs. In the predominantly customary and traditional Bangladeshi society, young unmarried adolescents girls are expected to be modest and protected from knowledge of sex, sexual experience and reproduction (Khan, et al., 2002). Moral disapprobation of premarital sexual activities means that general discussion and knowledge of such issues usually are very limited. (Rashid, 2000:28). Low levels of education coalesce to create an atmosphere of misunderstanding regarding sexual and reproductive health (Nahar, et al., 2020). Therefore, in the context of Bangladesh, it is difficult to inquire about sexuality or sexual and reproductive health for those who are unmarried because of its intimate characteristic and the aspects or norms of the society prescribe these issues to be kept inaudible and invisible as possible. Consequently, 'understandings of sexuality remain largely heteronormative, in which health rights are thought of in terms of reproduction and family planning between men and women, and information outlets and services continue to cater to married adolescents mostly' (Khan, et al.,2002:598) rather than if they are sexually active.

Moreover, due to the conservatism, negative attitudes towards homosexuals in Bangladesh are still very high. Inheriting from the British Indian Government's section 377 of 1860, homosexuality is not legal under Bangladeshi law and matter of punishment up to life imprisonment (Bangladesh Penal Code, 1860). Therefore, it is precarious for those who identify themselves as homosexuals to openly receive adolescence health services as homosexuals. Sexuality related social stigma and conservative mentality also inhibit to get proper health services for adolescents who engage in sex work or who are children of sex workers. Therefore, as a heterogenous group adolescents are marginalized and vulnerable due to a variety of factors in Bangladesh, especially adolescent girls do not get optimal conditions to develop their full potential and make sure their good health in their transition into adulthood.

III. Trends/Patterns of Sexual and Reproductive Health of Late Female Adolescent

a) *Early Marriage Among Late Female adolescents in Bangladesh*

The number of child marriage is remarkably high in Bangladesh. The median age at marriage for girls in Bangladesh still continues low compared other developing countries. The country ranks among the top ten countries in the world with the highest levels of child marriage. 51% of Bangladeshi girls marry before reaching age 18 and it is the home to 38 million child brides, including currently married girls along with women who were first married in childhood, of these 25 million married between 15-19 years (UNICEF, 2020).

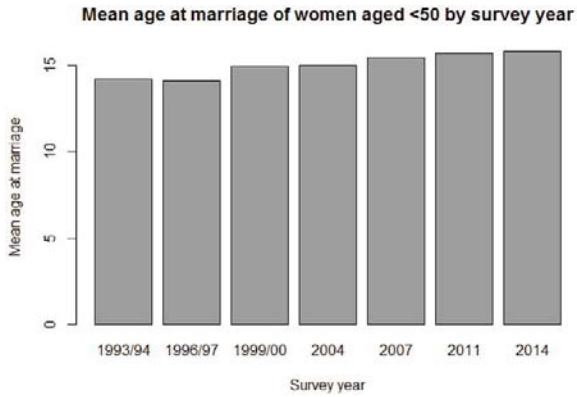

Figure 1

Though the age at marriage is still notably low, an important increase is observed since 2000 due to the factors like women's increasing participation in education, their urban resident and socioeconomic status (Presler-Marshall and Stavropoulou, 2017). According to the first survey carried out in 1993/94, (data shown in the Figure 1) the mean age of women at first marriage was about 14.25 years; it was barely reduced in 1996/97 (about 14.16 years). As 95% of Bangladesh girls experience their first period between 13.5 and 14.5 years of age, therefore, it has been observed that, until 1997, women got married around the age of puberty. A remarkable increase of almost 0.75 years of the mean age at marriage was observed in 1999/2000. It was nearly the same from 1999/2000 to 2004 (about 15 years). Later, it increased about 0.5 year in 200 (Zahangir and Nahar, 2021). This rising trend has been persisted and reached 15.86 years in 2014.This denotes that Bangladesh has been able to make some notable progress in decreasing early marriage.

As adolescent unmarried girls in traditional and conservative Bangladeshi society are highly protected from gaining any knowledge regarding sexual and reproductive health, therefore, at the time of marriage, they have very inadequate knowledge about sex and married life. A study conducted by Khan, et al., reveals that out of the total 54 respondents, 24 (44%) had no previous knowledge about sex before being married. Some participants mentioned that 'just days before their marriage, they were informed either in code words or vaguely about the sexual life' by their sisters-in-law, married friends or some elder female relatives in the family. By doing that they are mainly got ready to submit themselves to the wishes of their husbands (2002:242). This clearly establishes husband's authority on the

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sexual life and reproductive goals of that couples. The Demographic Health survey 2014 found that married adolescent girls aged between 15-19 years were the least compared to all women to be allowed to decide on family planning and reproductive health related decision making (NIPORT et al., 2016).

i. *Causes of Early Marriage in Bangladesh*

In Bangladesh, female's sexual roles are meant to be private and controlled (Khan, et al., 2002). Therefore, the main reason of child marriage is the gendered social norms that emphasizes a great value on female's chastity which is considered as central to family honor. When girls reach puberty, it creates a strong change in parents demand to marry off their daughters. Begum (2003) explains, "In Bangladeshi society a teenage daughter reaching menstruation becomes a burden for many parents because preservation of her virginity is the greatest concern for a bride. As a result … parents like to get their daughters married as early as possible "(p.86). Field and Ambrus, (2008) reported that more than 70% of first marriages occurred within 2 years of menarche in Bangladesh. Another reason of child marriage is poverty. As poorer families do not have the financial ability to invest in substitute options for girls, such as education. Parents see marrying off their daughters as an option to reduce economic hardship by getting rid of this burden through transferring it to her husband's family. In this context, for securing economic and social security, marriage of an adolescent girl, usually to an older man, is seen as a strategy. In addition, dowry which was outlawed in 1985 through "Dowry Prohibition Act", has also an implication for child marriage. The family of the bride has to provide the bridegroom a dowry. Younger brides usually needs smaller amount of dowries. Another important drive of child marriage is originated from the urge to continue male dominance and ensuring female obedience. It is believed by husband and his family that 'at a young age girls are like tender bamboos', therefore they can molded a young girl according to their wishes (Khan, et al., 2002: 242). Consequently, 'girls who have started to aspire to a world different from those of their mothers and their grandmothers find as their bodies evidence maturity that they are too often required to leave school and marry' (Presler-Marshall and Stavropoulou, 2017:1).

Since 1929 child marriage has been unlawful in Bangladesh and Child Marriage Restraint Amendment Ordinance, 1984 has established the minimum age of marriage at 21 for male and 18 for female. However, 'the problem is, in the early 2017s, the government of Bangladesh passed a new law titled "Child Marriage Restraint Act, 2017" that allows 'for child marriage to occur in "special circumstances". That is, with parental consent and with permission from the courts "the best interested of the underage female or male" can be married, while the minimum age at marriage (18 for women and 21 for men) did not change' (Zahangir and Nahar, 2021: 2)". The widely criticized new child marriage law in Bangladesh opens the door for parent to legalize the early marriage of their daughters.

b) *Early Pregnancy, Maternal Care and Maternal Mortality of Adolescent Girls*

Girls who marry at a young age face severe pressure to become pregnant. Therefore, because of the prevalence of child marriage and a continued predilection for childbearing, Bangladesh has the highest rate of adolescent pregnancy in South Asia. According to Bangladesh Demographic Health Survey (2014), 24.6% of 15–19 year old married adolescent have begun child bearing, 1 out of 4 has given birth and another 6 conceived with their first child (NIPORT et al., 2016).

However, despite having a high rate of adolescent pregnancy and childbearing, Figure 2 presents a declining trend in adolescent motherhood in Bangladesh to a slower pace from 1993 to 2014. In 1996–97, 31.0% of 15-19years old adolescent married girls became mothers, which reduced to 27.9% in 2004, and 24.6% in 2014. Lower spousal age gap, women's higher education, wealth level, urban residence and media exposure were found to exert strong affect in postponement in bearing children of among teenage girls in Bangladesh. Adolescent girls in the poorest wealth background were more likely to experience motherhood than the richest wealth level (41% vs 23%). Adolescent girls who had no education were observed to be pregnant or parenting 2.76 times higher odds than those who had higher than secondary education. The prevalence of motherhood among married adolescent girls was consistently lower in urban areas than rural areas. In urban areas, 27% of adolescent girls became mothers whereas 27% of their rural counterparts became mothers. Adolescent girls who had exposure to media were found to have 23.3% lower odds of experiencing motherhood compared to those who did not have media exposure. In addition, married adolescent girls with less than five years of spousal age gap had 55.3% lower risk of motherhood than teenagers with more than 10 years of spousal age gap (Islam, et al., 2017).

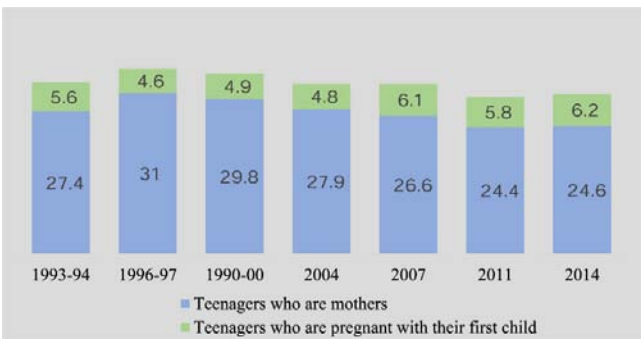

Figure 2

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i. *Causes of Early Childbearing*

A number of factors affect married adolescent girls' capability to delay early childbearing in the social context of Bangladesh. Embedded socio-cultural norms around gender roles, entrenched robustly in community and family contexts, equates a girl's value with her ability to child bearing. Girls perceived stigma related with delaying childbirth results in being seen them as infertile by their husbands, in laws or the larger community has powerful influence over the desire for their early child bearing for proving their fecundity. In addition, attempts to delay childbearing may also generate speculation that the married girl is having an extra-marital affair which threatens her position within the family and leave her open to potential physical and mental abuse by her husband and his family. Moreover, these young, adolescent girls also less likely to involve in family planning because of their lack of knowledge of contraceptives and 'male dominated partner dynamics' which establishes a limit on their ability to control the timing and frequency of childbearing. Besides, they face an inordinate number of barriers to access reproductive facilities within the formal health system including lack of physical or financial access to health services bias of providers and stigma around use of contraceptive (Samandari, et al.,2020).

ii. *Maternal Care in Bangladesh*

However, Maternal care in Bangladesh is comparatively well. Government has made health facilities accessible down to union level. Bangladesh Demographic Health Survey (2018) defines quality antennal care as ' a woman has four or more antenatal care (ANC) visits, of which at least one is with a medically trained provider, and receives all of the basic components of ANC (weight and blood pressure measurements, urine and blood tests, and information on signs of possible complications) at least once'. According to the BDHS 2018 definition, only 18% of women receive quality antenatal care and compared to other age groups, women in the age group 15–24 are most likely to receive antenatal care from a medically trained personnel. 72 percent of women have at least one or more antenatal care visits (NIPORT, 2020:122). Factors like women's education, household wealth, urban-rural residence and access to mass media have a significant positive association with the likelihood of receiving antenatal care from medically trained persons. Besides these factors, husband's education level, working/nor working women, religion (more non-Muslim women than Muslim women seeking assistance) were also found to have an important positive correlation with maternity care service utilization. However, the importance of the public sector as a providing source of antenatal care has declined. The private sector has now become the prominent source of antenatal care both in urban and rural areas. Therefore, quality of antenatal care has become related closely to wealth. Though there is a considerable rise among the poorest adolescent women in care seeking for maternal complications (the use of health facilities almost doubled in 2016), the disparity between the quality of care also observable. 37% of women from the highest wealth level get quality antenatal care, compared with only 7% of women from the lowest wealth level (Ibid).

Though there is a substantial increase in receiving antenatal care services, till now 62% of total deliveries still happen at home and more than 56% deliveries are occurred with the assistance of traditional birth attendants (TBAs) or relatives while medically trained provider conduct only 42% of all births, both at home and in facilities at the national level (NIPORT, 2020). Different factors driven people for preferring home delivery with a TBA. Firstly, due to the existing cultural practices, elder, especially female members of the family see giving birth at home as an age-old custom, hence, put restriction on expectant women for going to hospital. Religious fallacy regarding veiling is also a reason for preferring delivery at home. They think that if a pregnant woman physically opens herself to male doctors, it would be a religious sin. Another important reason for occurring deliveries at home is poverty. Poor people do not have enough money to spend on facility based delivery which requires patients to pay for the hospital facilities, cost of the medicine, transport etc. In addition, fear of increased possibility of having a caesarean delivery instead of attempting a normal vaginal delivery in hospitals and the derelict conditions of the roads and limited transportation facilities are also important reason for preferring home delivery (Sarker, et al., 2016).

iii. *Maternal Mortality*

Bangladesh made a significant progress towards achieving Millennium Development Goals (MDG) 4 and 5. According to Bangladesh Maternal Mortality Survey (BMMS) 2010, between 1990 and 2010, maternal mortality in Bangladesh decreased from 574/100000 to 194/100000 live births. However, the adolescent maternal (15-19 years) mortality rate is still very high (NIPORT, 2020). BMMS-2016 found that 134 adolescent mothers per 100000 live births died as a consequence of complications during pregnancy or delivery (NIPORT, 2018).

Different socio-cultural norms and superstitions still exist in Bangladesh and are creating barriers for achieving healthy and safe motherhood. Many of these customs involve putting restriction on women's consumption of adequate food during pregnancy and the post-natal period. In addition, still most of the women give birth at home and are assisted by traditional birth attendants. The deliveries are occurred in unsafe and unhygienic conditions resulting in

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increased risk of maternal mortality (Sarker, et al., 2016).

Maternal care seeking behavior is also other barriers for ensuring safe motherhood. Almost half of adolescent women have one or more complications such as convulsions, vaginal discharge, obstructed labor etc., during pregnancy but they do not seek treatment for those complications because either they think that the condition is not serious or the treatment for the complication is not necessary, therefore, only one in three seek treatment from a trained provider. Another common cause for not seeking maternal care is economical. More than three-fourths of adolescent mothers with time sensitive complications of convulsions or excessive bleeding either fail to ask for any treatment or seek treatment from an untrained provider because of the high cost of service (Ibid).

c) *Knowledge and use of Family Planning Methods among Late Female Adolescents'*

Bangladesh has proved itself as an extraordinary health performer in the area of maternal and child health regarding family planning. The country contraceptive prevalence rate rose from 8% in 1975 to 62% in 2014. At the beginning, the public sector remained the main source for distribution contraceptive methods for most of the users and government's family planning works were crucial in supplying the methods. The door to door family planning services provided by the country's government's contributed to reduce the total fertility rate from 6.3 births per woman in 1975 to 2.3 births per woman in 2014 (Shahabuddin, 2016). At present, the contraceptive prevalence rate among married female adolescents 15-19 years old are 56%. 51% of married adolescent use modern methods where as only 5% use traditional method. Due to the changing government policies private medical sector has become the major source of contraceptive supply for 64% of married adolescents who use contraception-most of them (61%) rely on pharmacies (NIPORT, 2020).

While only almost half of adolescent married girls aged 15-19 use contraception, this is not because they are lack of knowing regarding contraception as Demographic Health Survey (2014) found that 97% of adolescents married girls knew about contraception. However, though almost every married adolescent girls is aware about contraceptives, but many of them do not have the proper knowledge of using contraceptive (Pachauri and Santhya, 2002). Moreover, after marriage, they often receive incorrect or misleading information from sisters-in-law and neighbors, who become the primary source of their information, about contraceptive methods, especially as related to the risk of infertility, which discourage them from using contraceptives. As Married adolescent girls lack of mobility and less frequent contact of government health workers limit their ability to engage with the health services and the opportunity to remove their misconceptions regarding contraceptive methods, they are unable to make free and informed choices, hence, which results in low use of contraception. The use of low contraception is also most importantly linked to their low decision making autonomy to contraceptive methods use and pregnancy. Their age, a low level of education and financial dependency on husband's or his family put them in a situation where, frequently, their voices are ignored. Therefore, their husbands and mothers-in-law play the role of main decision makers regarding use of contraceptive methods and child bearing and they are expected to bear a child just after their marriage by putting her in a position of less empowered (Deb, et. al, 2011).

However, though 75% of unmarried female adolescents have knowledge about at least one of the three common contraceptive methods (oral pill, condom and emergency contraceptive pill, there is no official data regarding use of contraceptives among them. Demographic Health Survey and other national surveys have mostly excluded this group in terms of use of contraception. This is mainly because of the long held social norm that unmarried people do not engage in sexual relationship before marriage in a conservative country like Bangladesh. Therefore, very little is known about their sexual activity and contraceptive use. A Study by Pachauri and Santhya, (2002) reveals that around 6% of unmarried females were active sexually by age 18.5. This study indicates that a large number of unmarried sexually active adolescents do not use any contraceptive method. This is because they do not feel comfortable buying contraceptives from nearby pharmacies or clinics and see providers to be rude and judgmental (Rob, 2001). That may result in a high number of unsafe abortions as being pregnant before marriage is shameful and stigmatizing for themselves and their families (Espinoza, 2020). This is justified by a study conducted by Ahmed, et, al. (2005) which revealed that' unmarried female adolescents were 35 times as likely as married adolescents to abort (20 vs 733 abortions per 1000 births)' (cited in Espinoza, 2020: 189). Most of the abortions (57%) are assisted by traditional untrained providers and a less than half of the abortion are assisted by biomedical health workers through menstrual regulations as abortion is illegal in Bangladesh (Ibid).

d) *Intimate Partner Violence Against Late Adolescent Girls*

Intimate partner violence against married adolescent girls is very common in Bangladesh and is strongly linked to the low status ascribed to them. Violence is mainly manipulated as a tool for controlling women and various aspects of their lives. (Presler-Marshall and Stavropoulou, 2017). Bangladesh Bureau of Statistics carried out the first national Violence Against

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Women Survey of 12,600 women aged 15 and over in 2011. The survey revealed that 65% of married women experienced physical violence- mostly by their husbands. 42% of married adolescent girls experienced violence by their husbands. They experience different form of violence such as physical, sexual, verbal etc. Women's socio-economic dependency on husband, marital conflict, demand of dowry, disobedience to husband, drug or alcohol addiction of the husband etc., were found as causes of violence against women. A study by Pearson, et al., 2016 showed that Intimate partner violence was also related with the disagreement in fertility intentions within the family and contraceptive use. In this case women experienced fertility pressure and pregnancy coercion from their husbands or in-laws. Due to physical violence married adolescent suffered injuries. Sexually violated women experienced pelvic pain and reproductive tract infections. They also suffered from gynecological problems at the times of pregnancy more than non-abused women (Salam, et al., 2006).

Despite the realization that violence against women may be connected with serious consequences for women's lives, as a patriarchal and robustly hierarchical society, the pervasiveness of violence, especially physical violence is still socially accepted as a norm. Bangladesh Demographic Health Survey (2016) found that an important proportion of adolescent married girls aged 15-19 thought that husbands were justified in beating their wives if they argue with them, neglect the children or go out without informing him. Therefore, often victim do not feel that violence against them is something that is worth reporting. The 2015 Bangladesh Bureau of Statistics survey revealed that 70% of married women and girls who had experienced some form of abuse, never told anyone and less than three percent took legal action. As a women's rights lawyer commented 'society thinks domestic violence is silly violence, that it's something that normally just happens in the family' (Human Rights Watch, 2020:2). Besides this attitude towards the physical violence, sexual abuse or marital rape by husband is not considered as a crime as there is no law against marital rape in Bangladesh. If women married to the perpetrator, in that case forced marital sex will not be considered as rape. The main norm is that once a woman is married, her husband has the exclusive right to unlimited sexual access to his wife (Masoom, 2007). Therefore, these social attitudes, along with other issues, serve to produce even more barriers for victims in reporting the abuse as well as pursuing access to opportunities of legal redress and support.

e) HIV/AIDS and Sexually Transmitted Diseases (STDs)

Among adolescent population in Bangladesh, girls are more exposed to Sexually Transmitted Diseases (STDs) than their male counterparts, including HIV/AIDS. Married adolescent girls early sexual initiation, lack of power, lower ability to negotiate for safe sex, lack of access to contraception, lack of education and sexual violence are mainly responsible for their increasing vulnerability to STDs. Moreover, they do not have knowledge and awareness about STDs which make them more vulnerable to STDs (Hossain, et al. 2014). An UNAIDS Bangladesh study revealed that, only 12.8 percent of adolescents and youth had inclusive knowledge on HIV (cited in MoHFW, 2016). According to Bangladesh Demographic Health Survey (2014) showed that only 12 percent of ever-married adolescents had comprehensive knowledge about HIV/AIDS which further substantiates the low levels of knowledge about SRH issues among adolescents girls. A study by Uddin and Chowdhury (2008) revealed that about half of the adolescent respondents could not accurately recognize a single symptom of STDs and more than half of them could not precisely identify a mode of transmission of STDs.

Lack of knowledge about STDs also observed among adolescent sex workers. A study by Uddin and Chowdhury (2008) showed that only 32% of them had ever heard of AIDS whereas only 11% had knowledge of the transmission of HIV/AIDS by unsafe sex. Economic vulnerability of commercial female adolescent sex workers make them more vulnerable to HIV/AIDS. Their clients are significant sources of spreading HIV/AIDs in Bangladesh. In a survey carried out in Northern part of Bangladesh, more than 88% of sex workers reported having unprotected sex, because of clients' insistence (Garai, 2016).

f) Policy Issues and Challenges

The Government of Bangladesh has started to identify the importance of ensuring adolescent health and has adopted this issue in several of its policies. However, unmarried girls need have not recognized properly in those policies. Adolescent Sexual and Reproductive Health is still viewed as synonymous with family planning, which under the traditional Bangladeshi context is only allowed for married women and couples. As child marriage continues to be an important issue in Bangladesh, the needs of married adolescents girls are mainly prioritized through the policies, programs and interventions (Ainul, et al., 2017). The current five year development plan of the government has no particular guideline for unmarried adolescent girls and their SRH needs and other national policies and programs continue to limit unmarried adolescents access to SRH knowledge, information and services. The systematic marginalization of unmarried adolescents from SRH services make them more vulnerable to health risks and inequitable treatment.

Moreover, other vulnerable groups such as lesbian, gay, bisexual and transgender (LGBTQ) are completely ignored in the recommended measures,

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implementation plans and especially in the section on vulnerable adolescents and adolescent in challenging circumstances of National Strategy for Adolescent Health 2017-2030. Due to the traditional social norms and outlook, LGBTQ adolescent fall outside the current SRH care service system. Therefore, unrecognition of their specific vulnerability will make it more difficult for them to get the access of health services and optimal environment to ensure their overall health in their transition to adulthood.

Because of the social norm, institutional and policy related obstacles, most of the programs that are adolescent-specific do not have a significant focus on SRH. Programs which have included SRH-related components, have given a secondary focus on this issue, included it into other, more socially acceptable gender related programs such as child marriage and gender based violence. Issue (Ainul, et al., 2017). Therefore a recognizable focus on STDs, particularly HIV/AIDS services for adolescent is missing which is attributable to having a low level of knowledge regarding STDs among adolescents. Moreover, The extent of interventions addressing adolescent sexual and reproductive health issues is limited. The interventions are not taken at a large enough scale to produce a critical national response. Most of the interventions or programs maximum covers 8-10 districts. Therefore, these interventions have a little impact on the national level.

Overall, a lack of disaggregated data has also been emerged a key challenge in the evidence about late adolescence girls sexual and reproductive health. This is happens not only because much less research have been conducted on SRH issue, but also female adolescents aged 15-19 in Bangladesh are often grouped with adult women. Therefore, to design and implement strategies to promote late adolescent women's SRH in Bangladesh, it is crucial to focus on more age-specific research for getting more information on adolescent sexuality.

IV. Conclusion

Although the government of Bangladesh is exhibiting a strong commitment to address SRH needs of female later adolescents. However, still there are some big issues which are required to be addressed. In doing so government should focus on more research and including the voice of the adolescent girls in the decision making area so that their needs can be identified properly and they can act as an agent of change.

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Memberships

Fellows/Associates of Social Science Research Council

FSSRC/ASSRC Memberships



Introduction

FSSRC/ASSRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FSSRC/ASSRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FSSRC

Fellow of Social Science Research Council

FELLOW OF SOCIAL SCIENCE RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

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2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
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- Printed material
- Graphic representations
- Computer programs
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- Any other original work

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2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

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Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

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Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

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The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

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Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

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Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Social Science Research Paper

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1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of homan social science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

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12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

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Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.
Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

19. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

20. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

21. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

22. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

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Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



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Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

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- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

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Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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