

Solid and Liquid Waste Treatment (Slwt), Present in the South Sector of Rio Chillón, Altura Cuadra 60 Av Trapiche. Carabaylo-Lima District

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Abstract

The horizontal and vertical growth of the megalopolis Lima, given in three cardinal sectors: East, North and South, has generated millions of cubic meters of solid waste and a smaller proportion of liquid waste (LLW), hence the requirement for landfills such as: Coastal area between La Punta and Morro Solar, Pampa de los Perros (batatero La Cucaracha), Puente de Piedra, southern sector of the Chillón River at block 60 of Trapiche Avenue and northern sector of the Lomo de Corvina hill (Villa el Salvador). At the dump located in the southern sector of the Chillón River, some of the solid waste is eroded by meteoric waters, the difference being the river that transports it to the sea, a process that occurs during the rainy summer months when the river waters increase their flow due to high rainfall in the central highlands and crown of the basin (La Viuda mountain range). Once in the sea, solid waste from granitic, volcanic, luteous and calcareous igneous rocks are transported by currents that flow NW-SE. This geodynamic process favors the growth of beaches in the areas of Ventanilla, Ancon and Chancay. Complying with the principle of uniformity, the land that is reclaimed from the sea in these areas will be recovered by the sea in other places. The paper provides a management proposal for the better management of solid waste (RiLS) [5, 6, 7] as well as a bibliographic analysis to identify the theoretical basis for the creation of solid waste management strategies in different case studies.

Key words: Solid waste; civil engineering projects; Management of urban solid waste.

Resumen

El crecimiento horizontal y vertical de la megalópolis Lima, dado en tres sectores cardinales Este, Norte y Sur, ello ha generado millones de metros cúbicos de residuos sólidos y menor proporción de líquidos (RLS), de ahí emergió los requerimientos de botaderos tales como: Área costera comprendida entre la Punta y el Morro Solar, Pampa de los Perros (batatero La Cucaracha), Puente de Piedra, sector Sur Río Chillón altura cuadra 60 Av. Trapiche y sector Norte del cerro Lomo de Corvina (Villa el Salvador). En el botadero ubicado en el sector Sur río Chillón una parte de los residuos sólidos son erosionados por aguas meteóricas la diferencia por el río que lo transporta al mar, proceso que sucede en épocas de verano lluvioso es donde las aguas del río aumentan su caudal, por altas precipitaciones pluviales que se dan en la sierra central y corona de la cuenca (cordillera La Viuda). Ya en el mar los residuos sólidos provenientes de rocas ígneas granítica, volcánicas, lutáceas y calcáreas, son transportados por sus corrientes que tienen rumbo NW – SE. Este proceso geodinámico favorece el crecimiento de las playas en las áreas de Ventanilla, Ancón y Chancay. Cumpliendo el principio de uniformidad la tierra que es ganada al mar en estos parajes serán recuperadas por él, en otros lugares. El artículo da una propuesta de gestión para el mejor manejo de los citados residuos sólidos (RiLS) [5, 6, 7] así como un análisis bibliográfico para identificar las bases teóricas en la creación de estrategias para el manejo de residuos sólidos en diferentes casos de estudios.

Palabras claves: Residuos sólidos provenientes de la construcción de obras civiles, Manejo de residuos sólidos rocosos y urbanos acumulados en botaderos certificados.

1. Methodology

The study is aimed at developing an environmental management proposal for the proper treatment of solid and liquid waste (SLW) that involves the population and local and regional authorities, which led to the collection of on-site information.

Local authorities were informed of the possibility of transferring the solid and liquid wastes or to cushion them and/or protect them in the northern sector with a shield of igneous rocks to prevent them from being eroded by river flooding, thus mitigating the environmental agents generated by adverse physicochemical conditions. To this end, there should be a greater presence of municipal management in the current dump and in the three neighboring quarries that exploit aggregates (crushed stone, gravel, and gravel and sandstone) [1,2].

Liquid and solid waste (LSW) was evaluated and classified before proposing to the municipal authorities that the current landfill adjacent to the Chillón River be repositioned.

Coordination with the local (mayor) and regional (Callao Region) authorities continues, so that they can join the proposal, with good management in conjunction with the authorities of the Ministry of Energy and Mines, Ministry of the Environment, Ministry of Health and Civil Defense, which will generate a good social environment where they can implement part of the proposal.

2. Literature Review

Based on the bibliography registered in the Scopus database, a review of the scientific production related to solid waste management was carried out, finding a total of 16 documents whose variables are close to the study of the proposed topic, of which, 4 research works were carried out in the area of medicine, as shown in Table 1.

Subject area	Documents
Medicine	4
Business, Management and Accounting	2
Decision Sciences	2
Engineering	2
Environmental Science	2
Social Sciences	2
Veterinary	2
Chemical Engineering	1
Computer Science	1
Earth and Planetary Sciences	1
Economics, Econometrics and Finance	1

Table 1. Bibliographic production classified by area of knowledge
Source: Own elaboration (2021); based on data provided by Scopus.

There are 2 research papers in the area of Environmental Sciences both by authors with affiliation in Mexican institutions published in 2012 and 2019. The first one is entitled "Management and recovery potential of solid waste in a rural community in Mexico" (Taboada-González, Aguilar-Virgen, Cruz-Sotelo, & Ramirez-Barreto, 2013) whose objective is to analyze the process by which

solid waste is treated in rural communities that historically have lacked policies and mechanisms to manage such waste which leads to the creation of inefficient and inoperative sanitary systems, resorting to the practice of indiscriminate burning of such waste to reduce its volume. This study recognizes the current management of waste and evaluates possible alternatives to improve the use of some of these wastes in order to reduce environmental damage. It is concluded that, although it is true that there is recovery potential for certain components, the rural community lacks strategies and/or programs on the part of the municipal authority.

The second study identified in the area of Environmental Sciences was published in 2019 and is entitled "Solid waste management in Mexico" (Ojeda-Benitez & Saldaña Durán, 2019) which makes a description of how is the treatment given to solid waste in the North American country. This article highlights the following paragraph:

"In 2015, according to the World Bank, in Mexico waste generation was 53.1 million tons, the daily per capita generation reached 1.2 kilograms on average (Kaza et al. 2018). Of the waste generated, more than 50 percent is organic, a large part of which originates from food loss and waste. The former occurs during the production, storage, and distribution of food products; while the latter, when consumed food is discarded. Of the many environmental consequences associated with this situation is the contribution to greenhouse gas emissions (FAO 2013). In Mexico, estimates indicate that by 2020, the solid waste sector will be the fifth largest source of greenhouse gas emissions in the country (SEMARNAT 2016)."

Therefore, research continues to be conducted to measure the effects of pollution in cities such as Mexico City, designing strategies to optimize the use of solid waste and analyzing the processes that are currently being carried out by different fronts such as national and local authorities, private companies, state entities, among others.

An area of great interest for the development of this article is Earth Sciences, under which a research work entitled "Strategic choice and its application in the formulation of municipal solid waste management plans. Case study: Municipio libertador - Distrito capital" (Sánchez, Benaies, Vila, & Molina, 2006) whose main objective is to propose a change in the traditional system of solid waste management through the creativity of students in a postgraduate program at the Central University of Venezuela, who, as part of their preparation as Masters in Urban Policies and Local Action, propose improvements to the current systems in the central area of the Venezuelan capital, deriving from the same multiple plans and projects that draw the attention of the competent authorities. This case study was carried out by students and professors in the city of Caracas in 2006 and laid the foundations for the improvement of solid waste management strategies in the municipality of Libertador.

The countries that have developed the most studies related to solid waste management are also identified, with Brazil being the country that reports the most bibliography in the Scopus database, as shown in Figure 1.

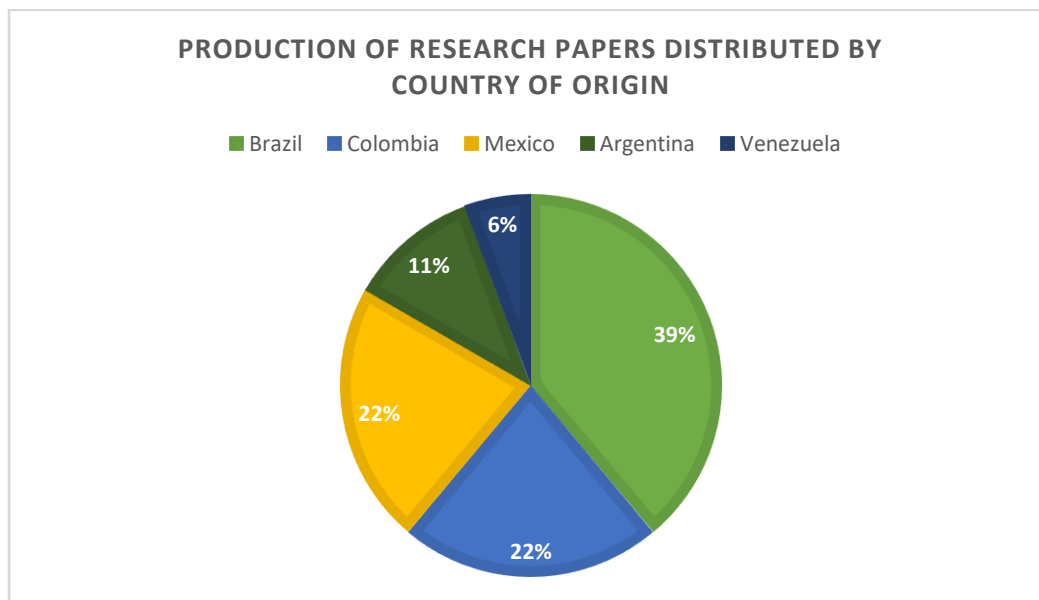


Figure 1. Bibliographic production classified by country of origin.
Source: Own elaboration (2021); based on data provided by Scopus.

Thirty-nine percent of the bibliography found corresponds to research works by authors affiliated with Brazilian institutions, as is the case of the paper "Solid urban waste: Socio-environmental impacts and prospects for sustainable management with social inclusion" (Gouveia, 2012), which proves the environmental damage generated in the short term by inefficient solid waste management. It is based on strategies for the correct handling of solid waste, generating inclusion in the processes, as well as in the reduction of waste through the strict use of the necessary material in civil works, recycling and reuse of material.

In second place is Colombia with 22% of the research papers registered in Scopus, including the article " Design of temporary storage for classification and management of ordinary solid waste applying systems" (Gutiérrez, Ochoa, Guarnizo, & Gutiérrez, 2021), which proposes alternatives to generate sustainable development in solid waste management from the perspective of areas such as architecture, civil engineering and environmental management.

2. Results

The bed of the Río Chillón in its southern sector (height block 60 Av. Trapiche) is used as a dumping ground for solid and liquid waste (SLW) that pollute the environment and its waters. The volume of this waste forms an irregular rectangular prism with the following measurements at its base and crown:

Length of its axis 3 km, the base is between 100 to 300 meters wide and the crown measures 100 to 200 meters wide, its four vertices are identified by the following UTM coordinates:

Vertices	North Coordinates	East Coordinates
V1 - NE	8686,000.00	276,000.00
V2 - SE	8685,800.00	276,000.00
V3 - SO	8685,800.00	274,000.00
V4 - NO	8686,000.00	274,000.00

Table 2. Vertices of the irregular rectangular prism.

Source: Own elaboration (2021)

The dump is identified in the topographic sheet at scale 1/100,000.00 24-i CHANCAY (SAD. 56-Lam.1), with the Google Earth the result of the fluvial erosion of these solid and liquid wastes (SLW) is observed, originated by the continuous floods of the river, a part of the whole is transported to the sea clogging and contaminating its mouth inside its delta that has the shape of a hen's foot.

The process described above has caused the death of nekton and saplings in the marine area of influence, and has also favored the growth of fluvial sands on the beaches of Ventanilla by decantation. These siliceous sands come from the erosion of the granites that are part of the coastal batholith (105ma), as evidenced by the petrographic studies in thin slices that follow:

MICROSCOPIC DESCRIPTION (MTA 1. E 276,000.00 N 8686,000.00)

GRANITE, plagioclase in micro tabular crystals, broken by stress, eudrales of 0.80 - 1.30mm, microcline in the lower central part and light yellow biotites, very faint sericite, regular idiomorphic texture.

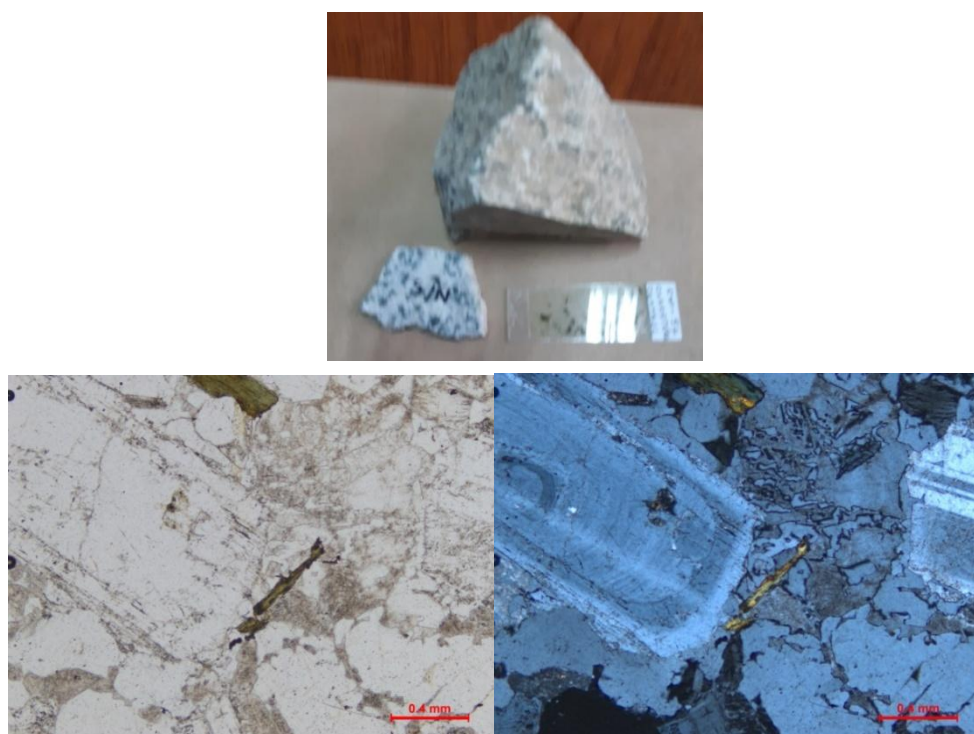


Figure 1. MICROSCOPIC DESCRIPTION (MTA 1. E 276,000.00 N 8686,000.00)

Nicoles //		Crossed Nicoles X			
Essential in %		Alterations %		Accessories %	
Orthose	60	Chlorite	3	Hornablenda	3
Quartz	5	Clay	6	Biotite	2
Plagioclase	15	Sericite	4	Opaque	2

Granitic rock of phaneritic or crystallophilic texture, factory resistant to marine dynamics, can be altered and decomposed superficially originating clays originated the siliceous sands, silts and clays carried by Rio Chillon.

MICROSCOPIC DESCRIPTION (MTA 2. dump center)

GRANITE, plagioclase in tabular euhedral crystals, intersecting veinlets, 0.60 - 1.50mm, feldspars at both ends, in the lower central part, faint chlorites, regular idiomorphic texture.

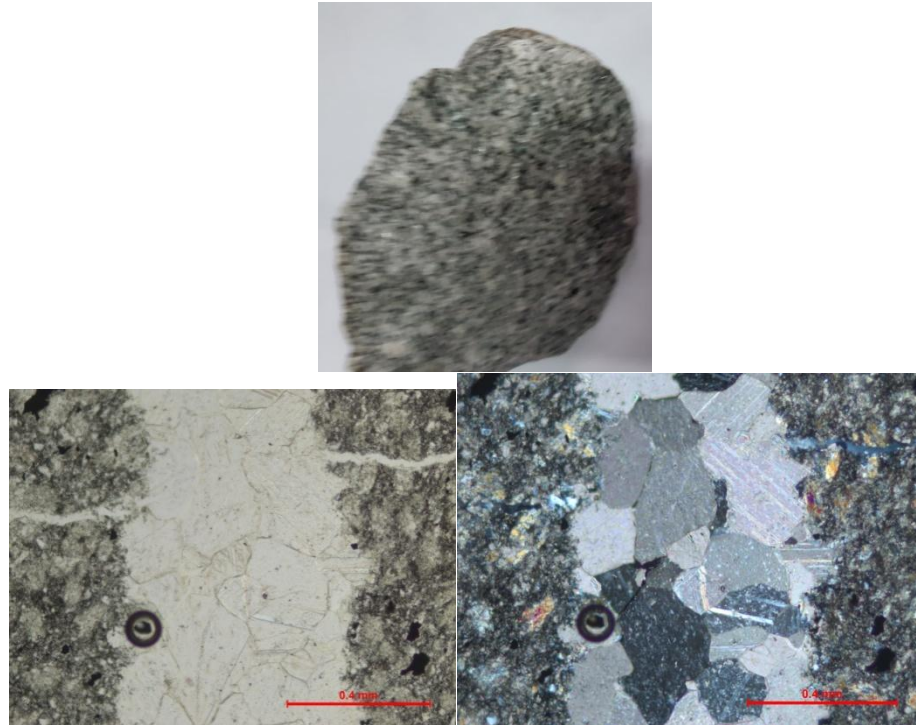


Figure 2. MICROSCOPIC DESCRIPTION (MTA 2. Dump center)

Nicoles //

Nicoles cruzados X

Essential in %		Alterations %		Accessories %	
Orthosa	40	Chlorite	3	Hornablenda	2
Quartz	10	Clay	30	Biotite	1
Plagioclase	10	Sericite	2	Biotite	2

Conclusion: granitic rock of phaneritic or crystallophilic texture and factory resistant to marine dynamics, can alter and decompose superficially originating clays originated siliceous sands

There are three quarries located in the southern sector of the river, 1 km downstream of the dump, where the extraction of boulders from the riverbed and the river terrace undergoes a daily crushing process that generates solid waste that contaminates and oversaturates the environment, damaging the health of children living in nearby areas with various skin and respiratory diseases, which must be prevented.

The entire volume of the irregular prismatic-shaped dump is within the political jurisdiction of the district of Carabayllo. Here it is verified that in the winter season from May to September, the river waters go down; in the summer season, the river waters rise, erode and transport a part of the landfill's mass due to a high percentage of solid and liquid waste (SLW) and discharge it into the sea.

According to information available, 80% of the total or total tonnage of solid waste (debris) comes from excavations in the soil and subsoil of Lima, such as work done for infrastructure or civil works foundations; 17% of the solid waste comes from demolition of homes and civil works (houses, buildings, Collique airport); and the remaining 3% comes from various types of waste (grease, oils, bird and mammal excrement, and household waste).

3. Discussion of results

The physical conditions given by the transit of trucks, vans and sporadic cars on solid waste, which circulate irregularly at present have caked it, its dynamic growth currently continues in progressive advance from west to east forming the irregular prism of wedged geometry, where environmental conditions continue to be negative in it and the area surrounding this dump, these are given by the particles of suspended solids in the air, as well as the pestilent atmosphere due to the decomposition of organic solid waste.

It has been verified that the solid waste from the landfill has been dumped in an uncontrolled manner through a discontinuous accumulation process, and that it is poorly packaged, which favors contamination of the waters of Rio Chillón, which, in times of summer rain or flooding, a large percentage of solid waste increases its load, gradually decanting along the way until most of it is dumped into the sea. The physical verification of the marine ridges present at the mouth and delta of Rio Chillón, which is the consequence of the discharge of solid waste from the dump described above.

There is evidence on site that the Ministry of Energy and Mines in a successful lightning and surprise operation DYNAMITE the facilities of the crushing plants of boulders, from which crushed stone or aggregates are obtained, its excess also added to the load carried by the river during the flood season.

4. Conclusions

The case studies that have been developed in different research works have made a very important contribution to the creation of strategies for the management of solid waste, in this case from civil works. And through the analysis of the identified bibliography, it is concluded in all the cases studied, the absence of efficient policies in the treatment of such waste, by the competent authorities who are directly in charge of the creation and design of policies that help the preservation of the environment.

Lack of adequate management by the civil defense authorities and the authorities of the Ministry of Transportation, the district mayor and the president of the Callao Region, who could carry out a classification of this solid and liquid waste to prevent the generation of large amounts of dust, the particles of which affect the health of the population of Carabayllo, Torre Blanca and others.

Lack of management by the Ministry of Health, which does not schedule on-site visits to evaluate the population living near the dump, with priority given to children affected by skin diseases



5. Recommendations










- This proposal will be presented to the municipal authority of CARABAYLLO, in order to support the elaboration of an ordinance, whose application will allow the closure of this dump, which pollutes the waters of Rio Chillón and the surrounding area, thus improving the health of the nearby population.
- We will indicate to the MEM authorities. Coordinate with the municipal authority to protect the northern sector of the dump with a rock armor to counteract and avoid the accelerated erosion caused by the waters of the Chillón River during the rainy summer season.

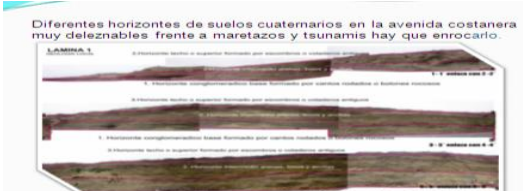




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Anexx 1. IMAGE PANEL

N° of IMAGE	DESCRIPTIVE DETAIL OF THE IMAGE	LEFT (a)	RIGHT (b).
1, 2	<p>a- Topographic map of Chancay IGN 24-i, SAD. 56. scale 1/100000</p> <p>b- BETWEEN POINT 15 AND POINT 11 IS THE COASTAL TRACK and parallel to the future Costa Verde track</p>		

<p>3, 4</p>	<p>a-Part of the Vía Costanera and cliff, IDEM will be the future Costa Verde.</p> <p>b-Shows on the top center of the image the dump, formed by waste coming from the district of Carabayllo.</p>		
<p>5, 6</p>	<p>a-In the lower part of the photo, the area is affirmed, with the probable intention of urbanizing the area in the near future.</p> <p>b-showing the erosion process of the river, Chillón, located on the north downstream sector.</p>		
<p>7, 8</p>	<p>a-Solid waste clogging the riverbed downstream, causing encroachment problems in the urbanizations.</p> <p>b-The areas located between the Pan-American Highway North and its mouth in the Pacific Ocean.</p>		
<p>9, 10</p>	<p>a-The flow of the Chillón River during the summer season from December to April.</p> <p>b-The waters easily erode the parapet of debris, clogging the riverbed downstream.</p>		
<p>11, 12</p>	<p>a-Showing the arrival of another truck with debris, this favors the parapet located in the southern sector of the Chillón River to grow.</p> <p>b-Crusher in the process of exploiting aggregates.</p>		

N° of IMAGE	DESCRIPTIVE DETAIL OF THE IMAGE	LEFT (a)	RIGHT (b).
13	a- Different horizons of quaternary soils in the coastal avenue, very vulnerable to tidal waves and tsunamis, it is necessary to castle it, progressive assemblies of images.	 <p>Diferentes horizontes de suelos cuaternarios en la avenida costanera muy deleznable frente a marejados y tsunamis hay que enrocario.</p> <p>LAMINA 1</p> <p>A. Horizonte de arena y grava formada por marejados y tsunamis.</p> <p>B. Horizonte de arena y grava formada por corrientes de aguas subterráneas.</p> <p>C. Horizonte de arena y grava formada por corrientes de aguas subterráneas.</p> <p>D. Horizonte de arena y grava formada por corrientes de aguas subterráneas.</p>	
14, 15	a-Area near the mouth of Rio Chillon, the Quaternary materials are unclumped. b-Rio Chillon in low water season, note the marine bead and the very polluted and pestilent water.		
16, 17	a- The person in charge of this work points out the sea bead and the contaminated water of the river. b- The trajectory of Rio Chillon before discharging its waters into the sea, polluting it.		
18, 19	a-The bridge and waters of the Chillon river very little shrub and tree vegetation on both banks. B-Image from another angle drug addicts form a large population living along the riverbanks.	