

Application of safety tools to reduce accidents in the company Geos Ingenieros S.R.L. [Aplicación de herramientas de seguridad para reducción de accidentes en la empresa Geos Ingenieros S.R.L.]

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Resumen

El desarrollo de la presente investigación tuvo como propósito determinar la influencia de los Procedimiento Escrito de Trabajo Seguro (PETS) operativos en actividades de procesos sobre la disminución de accidentes de una empresa Geos Ingenieros S.R.L. Por lo que el estudio fue del tipo aplicada con un enfoque descriptivo. Se empleó una población conformada por los trabajadores de las diversas áreas de la empresa. Así mismo, para el cálculo de la de la muestra se utiliza el muestreo no probabilístico por conveniencia; por lo cual la muestra estaría conformada por el personal del área de seguridad de la empresa. Esto trajo como resultado que el nivel de riesgos se haya disminuido notablemente, eliminándose los riesgos críticos en un 100 %, los riesgos del nivel bajo son los predominantes en un 90%, y un nivel de riesgos del nivel moderado en un 10%, indicando así que se ha logrado reducir notablemente el número de accidentes. Así mismo, se logró mejorar el nivel de conocimiento de los colaboradores el nivel de conocimiento sobre el uso de las PETS dado que paso de regular a excelente con un 72%. Por lo que se concluye que el uso de las PETS impacto positivamente, con una disminución total de los accidentes y mejor manejo de conocimiento en temas de seguridad.

Palabras clave: PETS, accidentes, seguridad, contingencia.

Abstract

The purpose of the development of this research was to determine the influence of the Safe Written Work Procedures (WSSP) operating in process activities on the reduction of accidents in a company Geos Ingenieros S.R.L. Therefore, the study was of the applied type with a descriptive approach. A population made up of workers from the various areas of the company was used. Likewise, non-probabilistic convenience sampling is used to calculate the sample size; Therefore, the sample would be made up of personnel from the company's security area. This resulted in the level of risks being significantly reduced, with critical risks being eliminated by 100%, low level risks being predominant by 90%, and moderate level risks by 10%, indicating so the number of accidents has been significantly reduced. Likewise, it was possible to improve the level of knowledge of the collaborators, the level of knowledge about the use of WSSP since it went from regular to excellent with 72%. Therefore, it is concluded that the use of WSSP has a positive impact, with a total decrease in accidents and better management of knowledge on safety issues.

Keywords: WSSP, accidents, security, contingency.

1. Introduction

The problem is focused because, in various sections of the tracks, deterioration and premature wear is very critical, it does not meet the objective of its designed and/or projected useful life. Caused by various factors, as well as the physical-mechanical composition of the affirmed materials used from our own quarries located along the sections to be rehabilitated.

The high values of work accidents in companies are a cause for concern; they reflect the lack of identification of hazards, lack of safe work procedures, evaluation and control of risks, which causes the occurrence of work accidents, in addition to, severe organizational and social problems, and economic losses due to cost overruns. Estimates from the International Labor Organization (ILO) suggest that, worldwide, 317 million people suffer workplace accidents each year, with 2.34 million fatalities as a result of these accidents or illnesses. In America, the proportion of fatal accidents per 100,000 workers is 11.1 in industry, 10.7 in agriculture and 6.9 in services (González et al., 2016).

In Peru, according to figures from the report of fatal accidents in mining, contract and related companies of the Ministry of Energy and Mines for the year 2000 - 2016, there has been a peak year of accidents where the number of people killed is 31, in companies mining companies, and 42 in contractors, until August 2, 2016, presenting high accident rates in companies due to inadequate safety management (MINEM, 2021). In Cajamarca, according to the bulletin issued by the SAT in 2020, 12 work accidents and two dangerous incidents were reported; However, the reality is different since the majority of accidents that occur in the development of various activities are not reported to the competent entity, which causes adequate controls to not be applied.

GEOS Ingenieros SRL., a company dedicated to the field of geosynthetics, lacks a Management System. Which presented conditions where accidents were generated that caused injuries (cuts on hands, blows, fractures, which occurred on different dates from 2016 - 2021), in addition to incidents caused by said collaborators. It should be noted that within the last 5 years it has presented an average annual growth percentage of 5%. From the above arose the need to analyze the company procedures that most influence the reduction of work accidents, a number that reflects the occurrence or not of unwanted events (accidents – incidents). Taking into account the results issued in this investigation, it is important to evaluate the indicators obtained and carry out effective implementation and monitoring, to improve the work environment, take care of the physical integrity of the collaborators and the productivity of the company.

Cifuentes (2019), in his statistical technical study aimed at the implementation for subsequent development and application of integrated mining safety programs, applied to Bierzo mining Universidad Politécnica de Madrid – Ingenieros de Minas-Madrid. The objective was to design the components of a safety plan to reduce the number of incidents and accidents, as well as scheduled and general evaluations of hazards. The study had a pre-experimental, quantitative approach, with the entire company staff as a sample and population. To meet the objective of the research, the functions and responsibilities of each chain of command were defined. Uniform and continuous evaluations of the comprehensive security plan of the security departments and committees were also carried out, as well as the establishment of procedural guidelines. In addition, the existing ecological studies of the Bierzo Mining were taken into account. The result was a systematized security system without regular supervision. Consequently, it is evident that the implementation of an integrated mining program is capable of controlling and reducing the number of incidents and accidents at work in the analyzed mine.

Córdova (2016), in the research on the development of WSSP and operational standards to minimize incidents – accidents in the mining company Lincuna S.A. In 2016, from the Santiago Antúnez de Mayolo National University, Huaraz, Peru. The main objective of the study was to develop WSSP and operational standards to reduce incidents and accidents. To achieve the

objective, health and safety awareness and observance was increased among staff to avoid incidents and accidents. To this end, the research focused on creating written protocols for safe action by the personnel participating in the project, deciding who should receive training and evaluating the number of hours of personnel trained during the months of 2016 at the Lincuna mine. The author's conclusion was that trained personnel play an important role in preventing incidents and accidents during their duties. This study will be beneficial for further research on the approach and use of indicators as a control of the OSH management system.

Ávila (2015), in the research determined the influence of the occupational health and safety management system based on the improvement of the preventive capacity of work accidents in the Barrick Misquichilca mining company – Laguna Norte” thesis to opt for the degree of doctor in planning and management from the National University of Trujillo. The objective of the study was to demonstrate how the SGSST influences the preventive capacity of the company, the research was of the descriptive correlational type, using the technique of observation and surveys; The study sample was 187 mine workers; The study concludes that the influence is significant and positive on preventive capacity, and that planned observations help reduce unsafe acts and conditions.

2. Materials and Methods

The research according to its purpose is of the applied type since its main purpose is to resolve the level of influence that the operational WSSP have within the company under study. Directed to the application through concrete actions to solve the research problem; quantitative in nature because it focuses on quantifying the impact of WSSP within the organization. Furthermore, quantitative research is characterized by its rigidity, standardization, and complete coverage of all aspects of the research process, from the formulation of the problem statement to the preparation of the final report.

The research presented a descriptive scheme with a pre-test and post-test group, to evaluate the effect of changes in the independent variable. The study figure is the following:

$$O1 \text{ ----- } X \text{ ----- } O2 \quad (1)$$

Where: X = operational WSSP; O1 = Number of personnel accidents (before); O2 = Number of personnel accidents (after).

Non-probabilistic convenience sampling was used to calculate the sample; Therefore, the sample would be made up of the security area personnel of the company Geos Ingenieros S.R.L.

Among the data collection techniques and instruments there are: Checklists, where this instrument was used to collect data, which consists of asking questions that can be closed or open according to the desired parameters as established in the title of this research; Survey, which was a technique for collecting information directly from reality with the participation of the entire sample.

For the procedure to be used, the following was carried out: determine the current situation, diagnose the incidents and accidents, apply the study instrument on the incidents and accidents of the activities of the personnel of the company under study, validate the hypothesis through of control indicators, present and discuss the results.

3. Results

Within the current context of how the company Geos Ingenieros S.R.L. develops. regarding safety, so through the defined instruments and tools, data collection was carried out on the number of incidents and accidents of the company's personnel during the period 2021. Under this premise, the generalities of the company were first presented, mentioning that it is an organization founded in 2002 in the city of Cajamarca, Peru, which is dedicated to the field of geosynthetic installations, pipes and all materials for civil works and assemblies in the construction, mining and industrial sectors. oil companies. The company aims to provide quality services that required helping its clients through staff with experience in the execution of installation projects such as resource management. The company's mission is to provide a service with excellence, efficiency and quality, that has all safety protocols and respects care for the environment. The company's vision is to be the first company in the field of installation services for mining, gas and other projects. Among the services provided by the company are: marketing, installation and maintenance of geomembranes (Polyethylene, PVC, Bituminous, others), geotextiles, geogrids, geodrains, geocomposites (GCL); supply, installation and assembly of plastic (HDPE, Polypropylene, PVC) and metal pipes (carbon steel, stainless steel, others); engineering and execution of comprehensive projects, for drainage and erosion control systems in open pit mining projects; construction and maintenance of leaching systems, solution management, drainage, conduction lines; waterproofing of batteries, pools, dams, pipelines and contingency systems.

Table 1: Number of incidents in the period 2017-2021 by service

Description	Years				
	2017	2018	2019	2020	2021
Geomembranes	4	5	5	8	10
Tubes HDPE	3	3	4	4	5
Engineering and comprehensive projects	1	2	3	4	4
Number of incidents	8	10	12	16	19

With respect to the diagnosis of incidents and accidents in the period 2017-2021, Table 1 shows the number of incidents that were recorded for each service provided by the company from 2017 to 2021, which indicates that there has been growth, where the number of incidents in 2017 is 8, in 2018 it is 10, in 2019 it is 12, in 2020 it is 16 and in 2021 it is 19. Likewise, the number of incidents grows annually by an average of 5%. The number of accidents was recorded for each service provided by the company. Through table 2 you can see the number of accidents that have occurred over the years, since 2017 it has increased from 6 to 14 for the 2021 period.

Table 2: Number of accidents in the period 2017-2021 by service

Description	Years				
	2017	2018	2019	2020	2021
Geomembranes	2	4	3	7	6
Tubes HDPE	3	3	4	5	6
Engineering and comprehensive projects	1	3	5	1	2
Number of incidents	6	10	12	13	14

An evaluation of the level of knowledge of the use of the WSSP was also carried out, where the way of answering was graded, if it was correct it was given the value of excellent, if I managed to respond correctly but incomplete it was given the value of regular and if he did not respond or if his response was completely wrong, the value of bad was attributed. Through Table 3 you can visualize the level of knowledge of the collaborators regarding the use of WSSP, from 2017 to 2021, where it is evident that the predominant percentage is the regular one with 42.86% in 2021, 78.57% in 2020, except for 2019 with 42.86%, 2018 with 71.43% and 2017 with 35.71%.

Table 3: Percentage level of knowledge about WSSP

Description	Years				
	2017	2018	2019	2020	2021
Bad (%)	57.14	21.43	42.86	7.14	0.00
Regular (%)	37.71	71.43	42.86	78.57	42.86
Excelent (%)	7.14	7.14	14.29	14.29	57.14
Total (%)	100.00	100.00	100.00	100.00	100.00

In relation to determining the influence of operational WSSP in process activities on the reduction of accidents of the company Geos Ingeniero S.R.L. The results showed that it was possible to determine the influence of the operational WSSP on activities, thus managing to significantly reduce accidents, given that the number of accidents in 2017 amounted to 6, 10 in 2018, 12 for year 13 and 14 for the year 2021, thus indicating an average growth of 5% annually. After the proposal, they managed to reduce it to only 2 per year, with a level of knowledge in the use of the collaborators regarding WSSP from regular to excellent, and finally managed to improve the management of security measures. It is worth mentioning that previous studies, such as those developed by researchers such as Cifuentes (2019), mention that to achieve the implementation of safety and health procedures at the company's work, a diagnosis of its work methodology and the plan of its activities is necessary, which which will allow the preparation of a safety work proposal to mitigate work situations and risks. Therefore, it is concluded that, in the same way as in our study, safety measures and the use of optimization of procedures such as WSSP manage to reduce the frequency of accidents.

Regarding carrying out a diagnosis of the current situation of incidents and accidents of the personnel of the company Geos Ingenieros S.R.L., the results showed that the number of accidents during 2017 amounted to 6, 10 in 2018, 12 for the year 13 and 14 for the year 2021, thus indicating an average growth of 5% annually, likewise the collaborators have poor knowledge of the management of WSSP, thus having a "regular" level of knowledge, and finally regarding their security management management the company's compliance level amounts to 46%, and 54% fails to comply according to the law, thus indicating that there are measures to still improve. According to Córdova (2016), safety factors in mining seek to know the risks through analysis of the processes and activities carried out in the study sector, in order to recognize the starting point to implement improvements to reduce accidents during their work. The study developed by Ichpas & Ichpas (2019) mentions that the accident factors allow the design of a prevention plan, its work methodology and the plan of its activities were diagnosed, where it was found that WSSP and IPERC are misused. work hours and fatigue are conditions that increase the risk of danger. Taking into account the results of the research against the detailed theoretical bases and previous studies, it can be inferred that any proposal for the solution and prevention of workplace accidents is based on an analytical and structured study referring to the frequency of accidents.

Regarding the design and implementation proposal for the use of operational WSSP within the activities of the staff of the company Geos Ingenieros S.R.L. Measures were used such as the

formation of a Responsibilities Committee in the SGSST, the policies in the SGSST, the Internal Safety and Health regulations at work, the development of an annual training program, the development of a Written Safe Work Procedure and the Development of Safety Standards. Security Lastly, prepare a contingency plan and emergency responses. For his part, Velezmoro (2019), in his research study, mentioned that an approach called the Safety Program for the prevention of substandard behaviors made it possible to reduce unsafe acts by 49%, as well as reduce the unsafe conditions identified during the process. For their part, Llanos & Llanos (2019), mentioned that direct safety measures for the rocky area, or for geomembrane installations, do not require as much cost or prior study, so it is easier to do a study and develop proposals for improvements to them. are. Taking into account the results of this specific objective, the detailed theoretical bases and previous studies, it can be concluded that there are different methods of contingency and prevention of occupational accidents, which can directly attack the problem through a comprehensive plan or different contingency measures.

Regarding the comparison with specific objective 3, which was to evaluate the impact of the use of operational WSSP within the activities of the personnel of the company Geos Ingenieros S.R.L., it was found that the level of risks was significantly reduced, eliminating the level of critical risks by 100%, low level risks are predominant by 90%, and a moderate level risk level by 10%, thus indicating that the number of accidents and risks have been significantly reduced, it is possible mention that now the level of knowledge among collaborators regarding WSSP is excellent. For his part, Carreño (2021) mentions that the change in safety measures is based on the control of safety and health procedures at work in the company, as well as both working hours and fatigue are conditions that increase the risk of danger. Meanwhile, Ávila (2015) determined the influence is significant and positive on preventive capacity, and planned observations help reduce unsafe acts and conditions. Therefore, it is concluded from previous studies and the results of this study that the management of WSSP allows the company's risks and accident frequency to be significantly improved.

4. Acknowledgments

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5. Conclusions

It was possible to determine the influence of operational WSSP in process activities on the reduction of accidents of the company Geos Ingeniero S.R.L, given that the level of risks has been significantly reduced, eliminating critical risks by 100%, low level risks are predominant at 90%, and a moderate risk level at 10%, thus indicating that the number of accidents has been significantly reduced. Likewise, it was possible to improve the level of knowledge of the collaborators to an excellent level. Therefore, it is concluded that the use of WSSP significantly reduces risks and improves the safety management of the company under study.

It was possible to carry out a safety diagnosis of the current situation of incidents and accidents of the personnel of the company Geos Ingenieros S.R.L, where the number of accidents during 2017 was found to be 6, 10 in 2018, 12 for the year 13 and 14 for the year 2021, thus indicating an average growth of 5% annually, likewise the collaborators have poor knowledge of the management of WSSP, thus having a "regular" level of knowledge, and finally regarding their safety management management the company's compliance level amounts to 46%, and 54% does not comply according to the law, so it is concluded that there is currently no accident prevention and there are measures to still improve.

It was possible to develop and implement solution measures to the safety problems of using operational WSSP within the activities of the staff of the company Geos Ingenieros S.R.L., using

measures such as the formation of the Responsibilities committee in the SGSST, the policies in the SGSST, the Internal Safety and Health regulations at work, preparation of an annual training program, preparation of a Written Safe Work Procedure and Preparation of Safety Standards Preparation, finally, a contingency plan and emergency responses. Therefore, It was concluded that measures were developed to best protect the safety of the personnel working at the Geo Ingenieros company as well as the reduction of work accidents.

It was determined that the implementation of the use of operational WSSP within the activities of the staff of the company Geos Ingenieros S.R.L. notably given that it has been significantly reduced, eliminating the level of critical risks by 100%, the low level risks are predominant by 90%, and a level of moderate level risks by 10%, the level of knowledge about The use of WSSP is excellent at 72%. Therefore, it is concluded that the use of WSSP has a positive impact, with a total decrease in accidents and better management of knowledge of WSSP.

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