

Characterization of the unhealthy and hazardous situations under the forensic expert survey and safety management in quarries

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Abstract

In the typical activities of quarries, it is common for the employees to be exposed to diverse risk factors, pertaining to their health or physical integrity. This kind of exposition, in Brazil, entitles these employees to additional payments, defined in law from different technical parameters. The controversies concerning the payment of these premiums between the employers and the employees, like the other conflicts between capital and labor, are solved in Brazil by the Labor Courts, and the forensic expert survey is one of the main tools used by the judges. This study aimed to characterize the unhealthy or hazardous situations in quarries using the forensic expert survey, focusing on the concepts and the legal definitions of the unhealthy or hazardous situations in labor activities, as well as the main aspects of the expert evidence technique and the judicial proceeding. This analysis revealed that most of the functions in quarries mean exposure to hazards, requiring appropriate management

Keywords: quarries, unhealthy, hazardous, expert survey.

1. Introduction

Mining companies that produce gravel for use in the construction industry from open pit mining using explosives and from rock beneficiation, such as granite and basalt, are designated as "pedreiras" in Brazil. This differentiates them from other types of mining, similarly to what takes place in countries such as the United States, where they are known as "quarries". In this type of undertaking, frequently employees involved in production and support operations are exposed to agents or risk factors. Several of these are typified by the legislation in force in the country as

causes of unhealthy (insalubrious) and hazardous work conditions and thus provide these employees with the right to an additional payment, also defined by law.

The recognition of this situation is not a simple task, requiring specialized technical work which is compulsorily conducted in light of the legislation governing the matter (Barbosa Filho, 2004). The lack or mismanagement of this work can, on the other hand, often lead to conflicts between companies and employees due to the lack of knowledge of effective exposure to hazards, improperly resulting in the

payment or not of premiums.

In Brazil, these types of conflicts between capital and labor are resolved by the Labor Courts, in accordance with Article 114 of the Federal Constitution (Fernandes, 2016). In this sense, among the lawsuits that follow the legal channels before this specialized justice, many have as their object an alleged employee exposure to unhealthy or hazardous conditions, consequently postulating the health hazard premium or the hazardous-duty premium on the salary. In order to find the existence or not of unhealthy or hazardous conditions alleged in labor proceedings;

it is the Labor Judge's prerogative to appoint an expert he trusts for the situation's analysis and the execution of an expert report, since this is a matter that requires the expertise of a qualified professional in the area – work safety engineers or occupational

physicians - pursuant to Article 195 of the Consolidated Labor Laws (CLT) (Saraiva *et al.*, 2016).

It is important to note that Article 473 of the Brazilian Civil Code Procedure establishes that for the performance of its function, the expert

can use all necessary means, hearing witnesses, obtaining information, requesting documents that are held by Government offices, as well as instruct the report with blueprints, drawings, photographs and other parts (Nery Jr. and Nery, 2016).

Characterization of unhealthy and hazardous conditions

The word "insalubrious" means everything that leads to disease or accident, whereby insalubrity is attributed to that which is unhealthy (Saliba and Corrêa, 2013). Similarly, the word "hazardous" refers to something or a condition generating danger. Thus, according to Pereira (2005), unhealthy differs from hazardous situations to the extent that the former reflects a situation of a health hazard, which is constituted through habitual exposure to a harmful agent, while the latter relates to situations where the worker is exposed directly to a dangerous agent that can take his life instantly or violate his physical integrity.

In Brazil, labor relations and employment, which also cover quarry employees, are currently governed by CLT, according to Executive Order 5,452 of May 1st, 1943 (Executive Order 5,452/43). In accordance with this Order's Chapter V, Title II, with writing given by law 6514 of December 22, 1977 (Law 6514/77), it is considered to be unhealthy those activities or operations which, by their nature, conditions or working methods, expose workers or employees to harmful agents that are above established tolerance limits, due to the agent's nature, intensity, exposure time, and their effects (article 189, CLT). In turn, dangerous activities or

operations, also referred to as hazardous, are defined as those which, by their nature and working methods, involve permanent contact with flammable material or explosives in conditions of accentuated risk (Article 193, CLT) (Saraiva *et al.*, 2016).

The characterization and legal classification of unhealthy situations, pursuant to CLT's Article 189, currently follows what is advocated by NR-15 1st to 14th attachments (Regulatory Norm 15), approved by the Governmental Decree 3214 of June 8, 1978 (Ministerial Order 3,214/78), in the form of Law 6514/77, which define the physical, chemical and biological agents that can provoke an occupational disease, once present in the working environment. The evaluation of these agents can be both: 1) quantitatively, whereby measurements are required with the employment of suitable instrumentation – sound pressure level meters and thermometers, among others, and 2) qualitatively, whereby the legal tolerance limits are usually monitored by on-the-job inspection.

In the case of hazardous situations, its characterization and legal classification, in accordance with the CLT's article 193, currently follows what is established by NR-16 1st and 2nd attachments (Regulatory Norm

16), approved by Governmental Decree 3214 of June 8, 1978 for explosives and flammable material. Also in effect are the requirements established by the Administrative Rule 1078 of July 16, 2014 (Administrative Rule 1078/14) for electric energy, and by Administrative Rule 1885 of December 2nd 2013 (Administrative Rule 1.885/13) for activities relating to property security. Finally, the Administrative Rule 518 of April 4, 2003 (Administrative Rule 518/03) regulates ionizing radiations (Malta, 2000; NR 16, 2015).

From a legal point of view, a hazardous condition can be defined as labor that subjects the employee to exercise activities with risk to his life or physical integrity, obliging the payment of the respective bonus. The definition of dangerousness is essentially legal. Therefore, it should be emphasized that only the situations foreseen by law are considered dangerous. Thus, not all situations in which the employee engages is an activity in which his life or physical integrity are at risk are applicable (Pereira, 2005). It is important to emphasize that, contrary to an unhealthy situation, the assessment of a hazardous situation is always provided for by legislation as qualitative, with the completion of the detailed analysis of the workstation and employee function.

2. Materials and methods

In general terms, the operations that are part of the quarry's productive process are basically: mining and beneficiation (processing), comprised of drilling and blasting of rock until its crushing and classification. It is important to highlight operations that involve moving parts and energy, such as loading, haulage and transportation. This type of undertaking usually also relies on a necessary support infrastructure, such as repair shops, offices or deposits, thus creating different work environments.

In this manner, for the analysis of unhealthy and hazardous situations in quarries under the legal and expert approach in order to propitiate its characterization according to legislation, the methodology employed was based on field visits to five quarries in the north-west region of the state of São Paulo, covering a period of three years. The methodology went from the observation and analysis of the work cycles in various sectors to the interview with the employees and directors. All available documentation related to work safety in

companies was also examined.

Therefore, initially a study of positions and functions was conducted. It has been ascertained that employees allocated to the mining sector in quarries typically perform the functions of supervisor and blaster, responsible for the direct conducting of the operations in this sector and coordinated by the enterprise's technical manager. In addition, there is the function of the mining equipment operators (Figure 1) for whatever the equipment may be, drills, hammers, tractors, loaders, and back-

hoes and trucks, who also assist in mining services. In the quarries' processing sector the employees perform the functions of supervisor, operator of crushing and classification equipment – crushers and screens - and auxiliary services, besides the wheel loader operator who is acting on stacking and reclaiming of crushed stone piles.

Considering its characteristics, the support infrastructure sector normally has groups operating equipment functions and installation maintenance, such

as mechanic, lubricator, supplier, tire repairman, electrician, tinsmith, welder, bricklayer and auxiliary services. Then there are expedition and support activities, such as drivers, and in the office, administrative, technical and commercial activities, there are the manager, mining engineer, surveyor, production scorer, administrative assistant and accountant, in addition to the general services assistants and watchmen.

In this manner, taking into account the typical distribution of op-

erations in quarries in the sectors of mining, processing and support infrastructure, several functions have been grouped in order to better support the analysis of the unhealthy and hazardous situations, in virtue of the same characteristics in terms of exposure to environmental agents and risk factors, constituting therefore "Similar Exposure Groups" (SEGs), which are defined by the occupational hygiene, as work units used for sampling and statistical analyses (AIHA, 2015).



Figure 1
Drill operator during mining operation in a quarry (author's picture).

Sequentially, the qualification of environmental agents that legally cause the unhealthy conditions (physical, chemical and biological) present in the activities and operations performed by the employees of quarries

3. Results

In the case of unhealthy conditions, it was observed that practically all functions exercised in quarries, among the previously related, entail the exposure to some kind of physical, chemical or biological agent, in the form of attachments 1 to 14 of NR-15 adopted by the Administrative Rule 3214, with the only exception being those employees allocated in the administrative sector, with usual activities carried out exclusively within the framework of supporting facilities such as offices.

In this way, for all functions in which the effective exposure to such agents is proven– without the adoption

was carried out, during work in the various working environments, according to the legal provision given by attachments numbers 1 to 14 of NR-15, approved by Administrative Rule 3214/78, as shown in Table 1.

of measures to mitigate or avoid such exposure – the health hazard premium will be due, defined by the CLT as incurring on the region's minimum wage, equivalent to 40% (forty percent) for maximum risk, 20% (twenty percent) for a medium risk, and 10% (ten percent) for a minimum unhealthy risk. In the case of the incidence of more than one agent, only the highest grade will be considered for the effect of salary increase, since the law prohibits the receipt of cumulative bonuses. (NR 15, 2008).

In regards to hazardous conditions, from the analysis of the activities effectively

Similarly, for the hazardous situations analysis functions, there have been identified those activities that involve explosives, flammable materials or electric power, having obtained the results sequentially described.

carried out in contact with risk agents or those carried out within areas of risk, effectively and not eventually, it was noted that the following functions encompass the execution of usual activities characterized as dangerous substances for explosives, according to the attachment number 1 of NR-16, approved by the Administrative Rule 3214/78: mining supervisor, blaster, mining services auxiliaries, lubricator, supplier, mining engineer and surveyor. Still with respect to hazardous situations, for the lubricator and supplier functions, one verified activities usually carried out in direct contact or risk area for flam-

mable materials, characterized as perilous according to annex number 2 of NR-16, approved by Administrative Rule 3214/78. Finally, the implementation of hazardous activities with electrical equipment and installations, identified as such according to Administrative Rule 1078/14, was characterized for the electrician function (Fantazzini and Cicco, 1994).

For all these functions, due to the work usually in contact with explosives, flammables or electric energy, a hazardous-duty premium on employee's salary will be due, except for awards or undistributed profits, equivalent to an increase of 30% (thirty percent) on salary as established by the CLT. It must be stressed, that even if the hazardous condition is established by more

than one agent, for example explosives and flammable material, the hazardous-duty premium will remain the same, i.e., there is no legal provision for the sum due to the coexistence of different hazards. Similarly, if a function simultaneously entitles the employee to the health hazard and hazardous-duty premiums, the employee must choose only one of them.

Table 1, below, summarizes the results that were obtained.

| PHYSICAL AGENTS | LEGAL PROVISION – NR-15 | GENERATING SOURCES IN QUARRIES | POSSIBLE HEALTH EFFECTS (*) |
|---|-------------------------|--|---|
| Noise | Attachments 01 and 02 | machines in general | hearing loss, stress and various organic effects |
| Heat | Attachment 03 | solar load | hyperthermia, dehydration, effects on the circulatory system and cramps |
| Ionizing radiation | Attachment 05 | not legally characterized | - |
| Hyperbaric conditions | Attachment 06 | not legally characterized | - |
| Non-ionizing radiation | Attachment 07 | solar load and welding machines | burns and effects on the eyes |
| Whole body vibrations | Attachment 08 | heavy machinery and trucks | musculoskeletal, nervous, digestive and circulatory disorders |
| Localized vibration | Attachment 08 | pneumatic picks | Raynaud's syndrome and effects on joints |
| Cold | Attachment 09 | not legally characterized | - |
| Moisture | Attachment 10 | wetlands or soaked areas | effects on the respiratory system and skin diseases |
| CHEMICAL AGENTS | LEGAL PROVISION – NR-15 | GENERATING SOURCES IN QUARRIES | POSSIBLE HEALTH EFFECTS (*) |
| Carbon monoxide | Attachment 11 | internal combustion engines in general | chemical asphyxia |
| Mineral dusts | Attachment 12 | rock drilling, processing, unpaved roads and off-road trucks | pneumoconiosis |
| Metal fumes and welding gases | Attachments 11 up to 13 | welding and cutting machines, oxy-acetylene | intoxication, chemical asphyxiation or simple and organic effects |
| Hydrocarbons | Attachment 13 | mineral products | skin diseases and various organic effects |
| Caustic alkalis | Attachment 13 | grout cleaning products | skin diseases |
| BIOLOGICAL AGENTS | LEGAL PROVISION – NR-15 | GENERATING SOURCES IN QUARRIES | POSSIBLE HEALTH EFFECTS (*) |
| Viruses, bacteria, fungi and parasites in general | Attachment 14 | infectious-contagious material- sanitary waste and discarded waste | infections, parasitic infections, allergic reactions and intoxications |

Table 1 Agents that cause unhealthy situations in quarries.

(*)Source: Parsons (1993), Burgess (1997), Salim and Carvalho (2002), Bellusci (2013).

4. Discussion

It should be noted that the name of the various positions and functions, as shown in Table 1, may vary from company to company, but essentially the same activities are developed. Similarly, there may be the accumulation of functions or activities for the same professional, for example, when the driver himself also carries out the function of supplying fuel to the truck, in which case he could have his job classified as dangerous due to flammable material, according to NR-16, 2nd Attachment.

Similarly, the activities developed in the risk area, notably in the case of explosives storage, can involve different functions depending on the quarry analyzed. Thus, if

supplies of explosives are deployed at distances less than those foreseen for the areas of risk defined by NR-16, 1st Attachment, from the processing and support infrastructure sectors, the risk area generated around these storehouses might include the workplaces of functions such as beneficiation supervisor, mechanical or even administrative assistant, which would thus have their work characterized as hazardous by virtue of being developed within this area of risk, as established by NR-16, 1st Attachment. Such considerations corroborate with the particular nature of forensic analysis, i.e. the unhealthy and hazardous situations survey of the functions of a particular quarry,

can only be considered fully valid when performed specifically having the referred quarry as object.

It must be stressed that staff will only be entitled to premiums while effectively exposed to physical, chemical or biological agents, in the case of unhealthy situations, or even working with explosives, flammables or electric power. In the case of hazardous situations, namely, in the event that such exposure be legally disqualified or eliminated, either by the adoption of individual protection, collective protection or administrative measures, the mining company will no longer have the legal obligation to pay premium payments (Gerges, 2003).

Unhealthy and hazardous situations management and safety management in quarries

The management of unhealthy and hazardous situations is inserted, in an integrated manner, within actions related to quality, environment and work safety maintenance, and is part of the global management of risks inherent in a mining venture. In this sense, the appropriate management of unhealthy and hazardous situations in quarries involves the adoption of distinct types of hazard control, culminating when effectively non characterizing the employee's exposure to environmental agents or risk factors, with the legal discharge of payment of the health hazard or the hazardous-duty premium.

Consequently, as an example of individual protection in quarries, equipment may be issued, such as plug or earmuff type hearing protectors, masks and respirators with or without filter, safety gloves and protective dermal creams. Collective protection measures, where the control of environmental hazards is conducted from its source or along the path of these until the exposed employee, involves enclosing machinery engines and equipment, wetting operations such as drilling, beneficiation and transporting, adopting shelters against the sun for field employees, grounding of electrical equipment,

and installation of bulkheads, among others. It is also important to emphasize that collective protection measures should, wherever possible, have priority over individual protection, as established by NR-6, approved by the Administrative Rule 3214/78.

With respect to administrative and engineering measures, these may be considered at the same time integrated and complementary to collective and individual ones, notably under the safety programs and occupational medicine required by the Brazilian legislation. In the case of quarries, these involve the continuous training and employee awareness regarding safety standards and individual and collective protection, the limitation of exposure time to environmental agents, along with the maintenance of facilities and appropriate equipment for emergency care and first aid provision, among others. Information systems, signaling and communication systems with employees can also be considered as an integral part of administrative measures.

However, even when there is the adoption of individual or collective protection measures, as well as administrative measures by the companies, some of the risks do not cease to exist for certain

functions carried out in the productive and support sectors of the quarry, notably in the case of hazardous work conditions. A clear example of this fact are the functions carried out in contact with explosives or energizing power installations, where the risk can be reduced but not eliminated, which would only happen if explosives or electricity are not used in quarries anymore, which is obviously infeasible, at least at the current stage of technological development. Thus, in a variety of situations observed in quarries, it becomes difficult, if not impossible, the non-characterization of hazardous situations, by virtue of hazards being inherent to certain activities.

In such situations the forensic analysis must be extremely judicious, especially in verification of the adopted measures of control, which can be effective in the neutralization of unhealthy situations, however not having the same effect in the case of hazardous situations.

Therefore, during the forensic analysis, it is of paramount importance to also identify and evaluate the existence of isolated functions which, by their very nature, will live up to the hazardous-duty premium on the salary, regardless of the existence or not of control measures.

5. Conclusions

As a result of the work done, it has been found that it is common most for most of the quarry functions, there is the occurrence of unhealthy situations, arising from exposure to physical, chemical or biological agents, or of hazardous

situations, resulting from work with explosives, flammables or electric power, both legally classified by the current Brazilian labor law.

Such situations may result in damage to the health or physical integrity,

in the case of employees, and financial damages, in the case of companies, from which have been verified some of the possible ways of managing the unhealthy or hazardous situations, in an integrated manner to actions related

to the maintenance of quality, environment and work safety, within the global management of hazards normally present in a mining venture.

The main instrument for the verification of unhealthy or hazardous situations is in turn the judicial technical expertise, which is performed by

a qualified professional and involves actions ranging from the analysis of documents up to field surveys, being the results embodied in the so-called expert report; a means of proof largely used by the competent authorities, such as judges in labor processes.

The gains with the correct assess-

ment and management of unhealthy or hazardous situations in quarries begin for the employees with the maintenance of their health and integrity, continuing for the companies that reduce their costs with additional payment, social security contributions and indemnities and finally are reflected throughout the society.

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