

HEALTH DAMAGE TO CIVIL CONSTRUCTION WORKERS DUE TO USE AND EXPOSURE TO CEMENT

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ABSTRACT

Civil construction has great representation for the socioeconomic development of our country. However, it is an activity that, if not carried out within the safety standards required by our labor legislation, provides great trends for labor incidents. The present work aims to address the risks inherent to the misuse of cement in the construction industry for the health of workers, having seen, because cement is a chemical agent that can be inhaled through the respiratory tract or, due to direct contact with the skin and mucous membranes, and also, by oral intake, provides the severe emergence of pathologies in the health of workers submitted to continuous contact with it. Initially, it will be presented characteristics of this material, as well as some examples of pathologies associated with the use of the product and, finally, emphasize the importance of the use of safety and prevention measures capable of avoiding the referred damages to the workers' health. For this, we used the methodology of bibliographic research in scientific sources already consecrated referring to the theme dissertated here that allow to prove the theme treated here. Thus, with the conclusion of the subject, it is concluded that it is necessary to use all necessary safety measures to ensure the development of the activity, but especially to ensure the integrity and health of workers who are in continuous contact with the cement.

Keywords: Civil Construction; Cement; Worker's health.

I. INTRODUCTION

In the preparation of the plans for the construction of buildings, it is of fundamental importance that, in addition to complying with all applicable laws and technical standards, special attention should also be paid to the correct use of cement.

As it has been seen, it is a material with large scale of use, not only in Brazil, but throughout the world, it must be handled properly, in order to satisfactorily meet the production of the product (building), both in the technical part. (safety, comfort, use, etc.), as well as, as regards the health of employees directly or indirectly involved in its use throughout the construction chain, from cement manufacture to finalization and delivery of the building. Referring to the importance of the construction industry for the economy of a nation.

The area of Civil Construction covers all activities of production of works, including activities from the planning and project functions to the execution, maintenance and restoration of

works in different segments: civil construction - relating to buildings for housing purposes, commerce and other services. ; and heavy construction - related to the construction of roads, bridges, viaducts, tunnels, ports, airports, navigation channels, sanitation works, hydroelectric works and other infrastructure works.

In addressing the safety and health of professionals directly involved in the production of concrete for construction, refurbishment and maintenance of buildings, it is necessary that the managers of the projects (small, medium and large) of construction, are committed to the development of techniques. and processes that enable the proper development of the activity, without harming the health and safety of its employees.

This paper aims to discuss the damage caused to the health of construction workers due to the use and exposure to cement, as well as addresses issues related to the harmful consequences and occupational diseases that may happen to workers' health, if not. Protective measures should be taken in accordance with regulations regarding the proper use of cement.

II. BIBLIOGRAPHIC REFERENCE

II.1 CONCRETE

Material widely used for buildings (residential, commercial, industrial, etc.) and works of art (bridges, viaducts, tunnels, etc.) is defined as a composite material consisting of a continuous agglomerating medium in which they are submerged. coarse aggregate particles (gravel, with particles larger than 4.8 mm) and fine aggregates (basically sand) [1].

Concrete is also known as a mixture of mortar and coarse aggregate where chemical additives are added to it that modify some characteristics of the concrete to facilitate application and improve its workability. However, the concrete composites, both small particles and chemical additives, make it possible to damage workers' health [2].

II.2 BINDERS

Binder and pulverulent material that promotes the union between the grains of the coarse and fine aggregates where they are used to obtain pastes, mortars and concretes. They are in powder form and, when mixed with water, form pastes which harden upon drying as a result of chemical reactions and after drying adhere to the surfaces with which they have been brought into contact.

They are active products used for the production of mortars and concrete, the main ones being cement, lime, hydraulic lime and plaster. Where in concrete, cement is used that reacts with water and hardens over time. On this subject, [3] states that the binders, such as lime, plaster and cement, are products used for grouting masonry or for the execution of coatings and structural parts. They are in powdery form and when mixed with water form a paste capable of hardening by simple drying as a result of chemical reactions.

II.3 BINDER PRODUCTION PROCESS

II.3.1 WHITEWASH

It is the product obtained by the calcination, at the high temperature of a species of raw material, limestone (CaCO_3) or magnesian rock (MgCO_3), which are as sources of the oxides that form lime. This calcination is done among other forms in intermittent furnaces, built with refractory brick masonry. There are two types of constructions under construction: hydrated (aerial) and hydraulic [4].

II.3.2 HYDRATED WHITEWASH (AERIAL)

Hydrated whitewash, common or air is a binder that hardens by reaction with CO_2 in the air, unlike hydraulics, which requires contact with water. From the "burning" of limestone rock in kilns, calcination at 900°C , "quicklime" or "virgin lime" is obtained [5].

II.3.3 HYDRAULIC WHITEWASH

Binder obtained by the calcination of limestone rocks, which naturally or artificially contain a considerable amount of clay materials. It has the property of hardening under water, although it is also hardened by the action of CO_2 from the air. Hydraulic lime production consists of limestone rock fragmentation followed by calcination and hydration [6].

II.3.3 PLASTER

Obtained from total or partial dehydration of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), natural material found in nature with some impurity content such as silica (SiO_2), alumina (Al_2O_3), iron oxide (FeO), and carbonate (CaCO_3), the maximum impurity content being limited to 6%. Gypsum is the most commonly used structural type of plaster in the cement industry. It is found in its natural state in large sedimentary deposits geologically.

II.4 CEMENT

It is estimated that 11 billion tons of concrete are consumed annually which, according to the Federación Iberoamericana de Hormigón Premesclado (FIHP), corresponds approximately to an average consumption of 1.9 tons of concrete per inhabitant per year, lower than the water consumption alone. [7].

One of the most commonly used raw materials in building construction, and one of the major sources of environmental contamination, is a chemical that can be inhaled by breathing, direct contact with skin and mucous membranes or even by ingestion by where it provides risks to workers' health through their use and exposure. Regarding the production process and existing compounds in cement, [3] points out that Cement is the result of a product called clinker, obtained by cooking until the incipient melting of a mixture of limestone and clay conveniently dosed and homogenized, such that all lime combines with the clay compounds without damaging the free lime after cooking. After firing, a small addition of calcium sulphate is made so that the SO_3 content does not exceed 3.0% in order to regulate the onset time of binder reactions with water.

Still on cement, [8] points out that cement has been present on the planet for over twelve million years, arose thanks to intense geological changes and spontaneous combustion processes that caused chemical reactions in limestone and shale deposits. It was this natural cement that was first used by man in Assyrian, Babylonian, Egyptian, and Greek constructions.

Regarding the industrial production of Portland cement in Brazil, [9] states that production began on an industrial scale from 1926 and, in the 1970s, it grew dramatically, which in the early 1980s exceeded 25 million tons, reaching 40 million tons per year in 2000 and, in 2010, production was 59.2 million tons per year.

II.4.1 RAW MATERIALS AND CEMENT CHARACTERIZATION

The production process of cement processing depends mainly on the following mineral products Limestone (CaCO_3) which is naturally present with impurities such as magnesium oxides (MgO). Knowing that lime, which is truly the raw material that goes into the manufacture of cement. Dolomite provides only 30.4% of CaO not used in cement manufacturing [4].

Also, according to the author, the clay employed in the manufacture of cement is essentially constituted of a hydrated aluminum silicate, usually containing iron and other minerals, in smaller proportions. The clay provides the SiO_2 , Al_2O_3 and Fe_2O_3 oxides required for the cement manufacturing process.

Gypsum is the final addition product in the cement manufacturing process, with the purpose of regulating the setting time during the sulfate hydration reactions. It is found in the form of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), hemidrate or basanite ($\text{CaSO}_4 \cdot 0,5\text{H}_2\text{O}$) and anhydrite (CaSO_4) [4].

Regarding the form of the worker contamination risk, cement can be characterized as a chemical risk agent, due to the substances, compounds or products that may penetrate the worker organism, either through inhalation, through the airways or under dust, fumes, gas, mist, mists or vapors, by dermal absorption (through the skin) or by ingestion.

According to [10] these agents can generate mutagenic, carcinogenic, teratogenic, organotoxic and immunotoxic effects in the body.

As a chemical agent, cement is classified as inert dust. Its color is gray and, when handled (deposited in concrete mixers), disperses a large amount of dust in the air. The moment dispersion occurs, the largest risk is the particle size (which can be inhaled) and its composition skin contact).

Basically, the material is formed by alkalis, i.e. a mixture of clay and limestone (calcium carbonate rock), also known as flour. More specifically, in the composition of the most common cements contains Calcium Oxide (CaO), Silica (SiO₂), Alumina (Al₂O₃), Ferric Oxide (Fe₂O₃), Sulfuric Anhydride (SO₃), Magnesium Oxide (MgO), Potassium Oxide (K₂O), Sodium oxide (Na₂O) and Chlorine (Cl).

Still on the composition of cement, [11] are categorical in stating that the main component of cement is limestone that, after being extracted and ground, is mixed with other minerals such as clay, iron oxide and aluminum oxide. This mixture, called raw flour, is sent to the ovens and calcined at high temperatures.

However, as [12] the main cement compounds are lime, silica, alumina and iron oxide are the essential components of Portland cement and constituents, generally 95 to 96% of the total in oxide analysis. Magnesia is usually present at 2 to 3%.

II.5 OCCUPATIONAL DISEASES

During the time of the development of the work activities developed by the company's employees, it is important that all necessary measures are taken to ensure the safety and health of the workers, so that they are guaranteed favorable conditions for the fulfillment of their activities;

In this way, they are assured that even during the period in which they perform their activities, they do not acquire the diseases that come from the bad conditions of the workplace, commonly called occupational or occupational diseases. Regarding the definition of occupational diseases at work, [13] are unanimous in stating that It is the diseases acquired during the exercise of work in the service of the company, causing bodily injury or functional disturbance that causes the death or loss or permanent reduction or temporary capacity for work.

II.6 DANGERS AND IMMINENT RISKS IN CONSTRUCTION

It is notorious that the work activities performed in the construction industry produce dangers and risks for employees, especially those directly involved in the construction process of the works. In dealing with dangers and risks, [14] state that danger is understood to mean a circumstance that foretells harm to someone or something, state, or situation that inspires caution in offering risks. The term risk may be defined as a combination of the likelihood of a hazardous event occurring with the severity of the injury, illness or loss that may be caused by the event.

II.7 RISKS DUE TO CONTACT OF CEMENT ON THE EMPLOYEE'S SKIN

According to [15], occupational risk is the likelihood of an adverse effect on the individual or the population by exposure to a specific concentration or dose of a hazardous agent. This definition encompasses two dimensions: the possibility that there is a negative result; and the uncertainty about the appearance, duration and magnitude of the adverse outcome.

Because workers are exposed to contact with cement for prolonged periods, they are exposed to the risks of contamination that cause severe damage to their health, such as: Damage to the cardiovascular, respiratory, renal, neurological, skin and others.

Because it is a pulverulent material, cement attacks the oral route and can develop stomach cancer, as well as, through the airway, also causes damage to the lung by inhalation of harmful substances to workers' health.

Therefore, it is of utmost importance that in the use of cement, the safety procedures that ensure employees do not acquire occupational diseases due to handling and contact with the cement are met.

Therefore, it is necessary to use adequate protective equipment to avoid causing damage to the health of the worker because cement is classified as an irritant material, i.e., reagent material in contact with the skin, eyes and respiratory tract. enable the emergence of damage to the health of employees. In this context, regarding the imminent risks to the workers' health caused by cement contact, [16] contributes to affirm that to better understand, cement reacts in contact with the epidermis due to its moisture (body perspiration), after prolonged contact. . The release of heat, by reaction in contact with liquid surface, causes injuries ranging from burns to contact dermatitis. It is common to observe the alkaline action of cement on the surface of the skin (especially hands and feet) in construction workers. Cement exerts an abrasive effect on the horny layer of the skin. The lesions are clearly visible: redness (erythema), swelling (edema), eczema, blisters, fissures and tissue necrosis.

II.8 DISEASES FROM IMPROPER USE OF CEMENT

II.8.1 OCCUPATIONAL ACNE

According to [17] occupational dermatosis is the alteration of mucous membranes, skin and its attachments that is directly or indirectly caused, conditioned, maintained or aggravated by agents present in occupational activity or in the workplace.

However, according to [18] the hygroscopic properties of cement and the presence of complex metal compounds are responsible for the sensitivity manifestations on the skin of some workers.

Also, according to the author, the frequent contact of cement with the skin can cause some kind of skin lesion in some of them, from skin dryness, irritation or chafing of the hands, feet or any place where the cement based product.



Figure 1: Worker with chronic allergic eczema caused by contact with cement.
Source: [19].



Figure 2: Worker with eczema and foot infection caused by direct contact with cement.
Source: [19].

II.8.2 IRRITATIVE CONTACT DERMATITIS BY CEMENT

As [20] cement is very irritating to the skin, its alkalinity often reaches a pH close to 14.1 For this reason, cement should be handled with hygienic care and personal protection. Several dermatoses can occur after cement contact with workers' skin.

According to [21] occupational dermatosis comprises all skin diseases directly or indirectly related to work and contact dermatitis is the most common and frequent, representing about 80% of existing dermatoses in workers in general.

II.8.3 PNEUMUCOSES CAUSED BY CEMENT MISUSE

Pneumoconiosis are occupational chronic diseases caused by the slow, repeated and durable action of inhaled or aspirated dust particles or powders.

According to [22] they are occupational or occupational diseases that have a high rate of morbidity, disability and mortality of the working population in the period of higher productivity.

According to [17], pneumopathies related to inhalation of chemical dust in the workplace are called pneumoconiosis, which are inhalation diseases of substances that the body can little fight with its immune defense mechanisms.

As [19] the symptoms of pneumoconiosis are shortness of breath and cough and if suspected, tests should be performed to confirm changes in the lungs.

II.8.4 SILICOSIS

For [17] silicosis is the most prevalent pneumoconiosis in Brazil, where all silica exposure situations where there is a risk of silicosis are verified, as well as peculiar exposure situations.

Second [22] is a chronic pathological condition of the lungs due to inhalation of particles containing free or non-combined silicon oxide (SiO_2), is recognized in Brazilian law as "occupational disease", thus covered by the legal concept of "work accident".



Figure 3: Worker with advanced stage silicosis.
Source: [19].

Because silicosis is a slowly developing disease and can progress independently of continued exposure, most cases will only be diagnosed years after the worker has been removed from exposure [17].

II.9 SECURITY MEASURES

In order to regulate the work safety in the construction industry in Brazil, regulatory standards were elaborated, among them, the Regulatory Standard (NR) 18 - Conditions and Environment of the Work in the Construction Industry, which has as main objective, to establish administrative, planning and organizational guidelines that aim to implement control measures and preventive safety systems in the processes, conditions and work environment in the Construction Industry.

As well as, not only NR-18, but other NRs, pursue the same objectives, among them, NR-6 that deals with personal protective equipment, device or product, of individual use used by the worker, intended for the protection of risks likely to threaten safety and health at work.

III. MATERIALS AND METHODS

For the development of this work and to achieve the proposed objectives, the present work was based on bibliographical research related to the subject here addressed, as well as, after obtaining and cataloging the content and scientific sources of research, the organization and contextualization was developed. of the theme discussed here.

Thus, after the development of the subject, we seek to present and discuss about the results from the theme addressed here.

IV. RESULTS AND DISCUSSION

With the completion of this work, it is found that cement is a material that is highly harmful to workers' health. This is observed in the damage it can cause to the health of workers who are continuously subjected to contact with the cement.

These damages are proven through diseases already known and scientifically cataloged, such as Dermatoses, Dermatitis, Pneumoconiosis, Silicosis and others.

Therefore, it is not necessary to address that all possible measures should be adopted to ensure the integrity of the health of workers in the construction industry who are in direct and continuous contact with Portland cement.

V. FINAL CONSIDERATIONS

After analyzing the subject here, it is observed that the improper use, the neglect of the use of protective equipment and the lack of control and safety measures in the activities that involve the continuous use of cement, causes great damages and, in irreversible to workers' health.

In addition, the lack of use of PPE - Personal Protective Equipment greatly aggravates the quality of health of workers because, often, they develop their activities with slippers, sandals or shorts, as well as the lack of training causes that the vast majority do not wear a protective mask, goggles or gloves on site, regardless of their size.

Thus, it is of fundamental importance to make everyone aware, not only of workers, but especially of managers, developers, builders, customers and, all involved in the construction industry, about preserving the health of workers who are involved daily. and

continuously in direct contact with the cement. For only in this way is the evolution of progress possible, but by guaranteeing the integrity of human life.

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