International Research Journal of Public and Environmental Health Vol.1 (7),pp. 158-164, September 2014
Available online at http://www.journalissues.org/IRJPEH/
http://dx.doi.org/10.15739/irjpeh.002
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ISSN 2360-8803

*Original Research Article*

# Oculopathy within workers of Beninese cement industry of Xwlacodji (BCI) in Cotonou (Benin)

Accepted 14 September, 2014

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**Eye, an important organ is neglected in environmental and occupational medicine. The present study carried out in the factory of cement of the BCI at Xwlacodji allowed us to identify eye disorders among workers. 106 staff of BCI were enrolled for the study (53 staff working in the very dusty and 53 staff working in the less dusty area of the company). Ophthalmological examination was conducted with examination torch, ophthalmoscope, Schirmer strips and fluorescence along with eye drops. The results revealed that pruritus represents 60 % of the symptoms and 65.7 % of those who complain about it reported a remission during holidays. Also, 79.2 % of the people working in the very dusty sections presented eye disorders compared to 50.9 % of those who work in the less dusty sections. These clinically identified disorders were essentially pinguecula and pterygium. Besides, 69.8% of the people more exposed to the dusts of cement suffered of eye disorders compared to 62.26 % of the people less exposed. Sixty four percent of the workers who often received cement dusts in eyes presented eye complaint. These different results showed that the activities of cement industry cause eye disorders to workers and it urges to take measures in order to mitigate the harm.**

**Key words**: eye disorders, exposure, cement industry, Xwlacodji, Benin

## INTRODUCTION

Air is the basic necessity of human life, but the quality of air is deteriorating continuously by constantly pollution of unplanned discharges atmospheric pollutants resulting from intense industrialization, population explosion and urbanization. Numerous epidemiological studies have demonstrated short-term associations between high levels of air pollution and increased acute mortality and morbidity Lippmann et al. (2000); Katsouyanni 2001; Petroeschevsky (2001). The intensity and nature of the damage is a function of the concentration of the pollutant and the duration of exposure (dose). One of the major sources of air pollution are automobiles and industries, as per estimates vehicular pollution is the primary cause of air pollution in urban areas (60%), followed by industries (20-30%) (Mehraj and Bhat, 2014).

Cement industry is one of the most basic industries involved in the development of a country as cement is the most widely used building material throughout the world. Cement manufacturing has caused environmental impacts at all stages of the process. These include emissions of airborne pollution in the form of dust, gases, noise and vibration when operating machinery and during blasting in

quarries, and damage to countryside from quarrying (Mehraj and Bhat, 2014). The various pollutants from cement industry include particulate matter (Suspended and Respirable), Nitrogen oxides, Sulphur oxides, Carbon monoxide, Volatile organic compounds (VOC) and Green House Gases (GHG); other substances include: Acidic compounds, Heavy metals – Cadmium, Lead, Mercury and Nickel (Mehraj and Bhat, 2014). It is due to emission of such and other lethal pollutants that the cement industry finds place in the red category club i.e. the most polluting industry (Ministry of Environment and Forest, Government of India and Central Pollution Control Board) Mehraj and Bhat (2014).

Several studies have also demonstrated linkages between cement dust exposure, chronic impairment of lung function and respiratory symptoms in human population (Isikli et al., 2003; Zeleke et al., 2010). Cement dust irritates the skin Isikli et al., (2003), increased frequency of respiratory problems (Al-Neaimi et al., 2001; Zeleke et al., 2010), risk of chronic respiratory illness Sivacoumar (2001) and gastro intestinal diseases Adak et al. (2007).

Besides health, cement factories also have great effect on the environment. The exhaust gases and particulate matters of the dust exhausted from cement plants degrading air quality and thus creates considerable environmental pollution. The impacts of cement industry are countless and exposure to cement pollution has been linked to a number of different health problems, starting from modest transient changes in the respiratory tract and impaired pulmonary function to mortality (Zeleke et al., 2010); Schuhmacher et al., 2004; (Aydin et al., 2010).

Moreover**,** eye is a Neglected Organ in Environmental and Occupational Medicine (Rozanova et al., 2009)though it is an important organ whose alteration can degrade the quality of life. In fact, blindness and sight impairment have greatly affected the individual and the society in terms of degradation of the quality of life, productivity, income and autonomy (Camara, 2006). The first world estimations of the sight impairment and its causes were based on the statistics of the world population in 1990 (38 million blinds); it was then extrapolated to 1996 at 45 million blind persons suggesting that the number of cases is certainly going to double in 2020 (Sidibé, 2004). The frequency of eye wounds in the buildings and public works sector (22/1000) comes in the second position after the manufacturing sector (24/1000), Desnoyers, (1982).The dust represents 11.8 % of the eye wounds (Desnoyers, 1982).

In Benin, the exponential increase in demand for cement has resulted in the proliferation of cement factories in other to meet supply. It is acknowledged that cement industry is a major source of the imbalances of the environment and producing air pollution hazards. The industry releases huge amounts of cement dust into the atmosphere which settle on the surrounding areas and causes various adverse effects. The present study is aimed at assessing the effects of the cement dusts on the eye health of the workers of Xwlacodji cement industry in order to suggest adapted prevention measures.

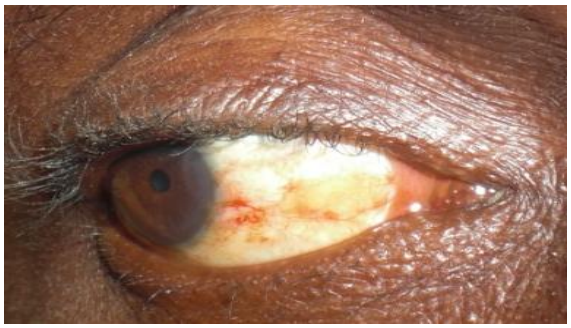
## MATERIALS AND METHODS

This study took place in the factory of the Beninese Cement industry (BCI) at Xwlacodji between August, 2010 and January, 2011. BCI is situated in the 5th district of Cotonou (Republic of Benin) between 2°26 ' 15 " and 2°26 ' 30 " eastern latitude and between 6°21 ' 0 " and 6°21 ' 5 " northern longitude. The population of Xwlacodji is about 32864 (Attanasso, 2007). One hundred six staff of BCI was enrolled for the study (53 each from those working in the very dusty and less dusty area of the company). A digital camera to take photographs was used. Additionally, examination torch, ophthalmoscope, Schirmer strips and fluorescence along with eye drops were used for the ophthalmological examination of workers.

Fifty-three staff working in sections very covered with dust (storage, grinding and packaging) and the rest in less dusty sections (electricity, garage, transport, transit, store, hygiene and administrative offices) were invited to participate in the data collection. The sampling was carried out in compliance with ethical rules and procedure. Written informed consent for participation of the workforce of the cement industry was received from all participating workers before the commencement of the investigation. A questionnaire of thirteen questions was administered to every worker. Additionally, an ophthalmological check-up was conducted including distant vision with a Snellen chart and near vision (Parinaud scale) and the various structures of the eye (eyelids, lacrimal punctum, conjunctivas, cornea, lens and posterior segment of eye) were examined by means of a torch and ophthalmoscope. Strips of fluorescence were introduced into a lower sulcus of the eyes after instillation of anaesthetic eye drops (Cebesine 0.4 %: Oxybuprocaine) to look for corneal injuries. Dry eyes were identified by the introduction of Shirmer strip in the lower eye sulcus. A checking program including standardized protocols for data collection, training of studied personnel and interviewers allowed us to reduce the bias at all levels. The data were analyzed by means of the SPSS software version 20. The significant value is $P < 0,05$.

## RESULTS AND DISCUSSION

Eye, a substantial organ in everyday life is a Neglected Organ in Environmental and Occupational Medicine (Rozanova et al., 2009). Several environmental factors have been suggested to trigger eye disorders including high altitude (Lu et al., 2008) wind and air pollution (Sahai and Mali, 2005). The results of our investigation on impact of



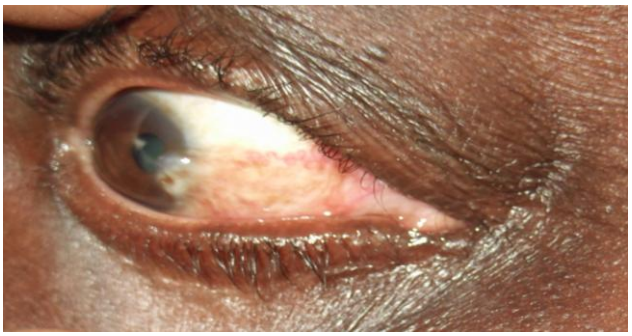
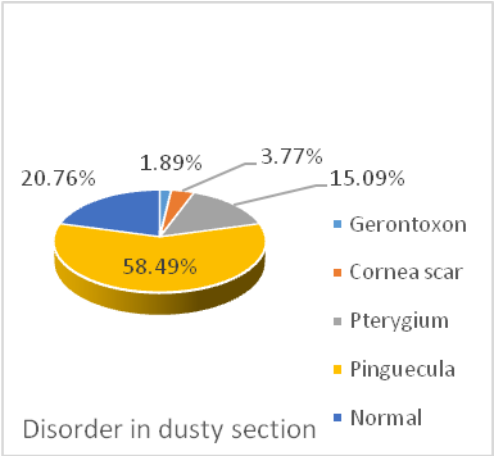


**Figure 1**:( a) Nasal pinguecula in the right eye of a worker (b) Pterygion in the right eye with a worker of packaging section



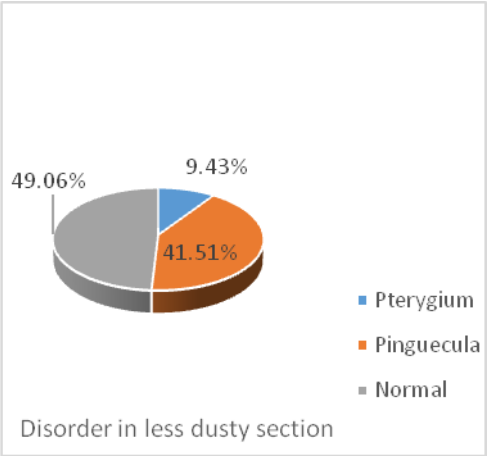




**Figure 2**: Relationship between exposure to dusts and disorders Figure 3 shows the relationship between exposure to dust and complaints

cement industry activities on eye health in workers could be presented under various aspects.

**Complaints recorded**

Out of the 7 various symptoms recorded as complaints, pruritus was the dominant one (60 %), followed by conjunctival secretions (12.9 %) then watery eyes (11.4 %). Several studies investigating the direct effect of air pollution on the eye have reported eye irritation or pruritus as the most common effects of air pollutants (Sahai and Mali, 2005; Novaes et al., 2007). Manifestations range from minimal or no symptoms to chronic discomfort and eye irritation (Altshuller, 1977), reduction of visibility, and increased light sensitivity Basu, 1972. Pruritus is an allergy which incites to the scratching of eyes. These workers then scratch their eyes with their fingers covered with cement; thus resulting in conjunctival secretions. These secretions are manifestations of conjunctivae infection. The National Institue for Occupational Safety and Health (NIOSH) reported eye infections which resulted from the contact of eyes with fingers among workers in the United States (CDCP, 2005)

**Influence of the administrative leave on the symptoms**

Out of 70 people who complained about eye disorders, 46 (65.7 %) admitted a decrease of the symptoms during the administrative leave (24 working days) versus 9 (12.9 %). This remission of symptoms during the administrative leave could establish a connection between exposure to cement dusts and the complaints. Either allergic or irritating conjunctivitis were observed and blepharitis corresponding to the injury of the hairy follicles of lashes by cement dusts (Courtois, 2002). Figure 1 depicts some eye disorders recorded during examination and Figure 2 shows the distribution of disorders among examined population:

Versura et al. (1999) also reported eye surface damages in a clinical study in the winter and summer using the Schirmer's test I, ferning test, breakup time (BUT), and conjunctival cytology (scraping and imprint). They demonstrated that eye surface cytology and the analysis of

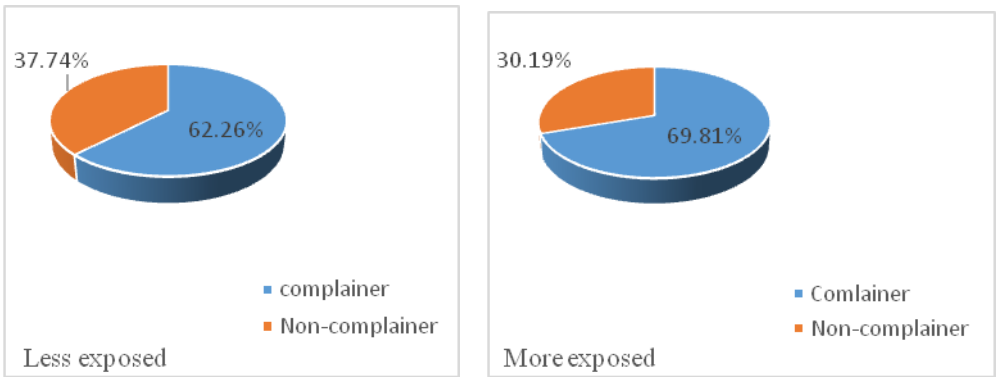



**Figure 3**: Relationship between exposure to dust and complaints

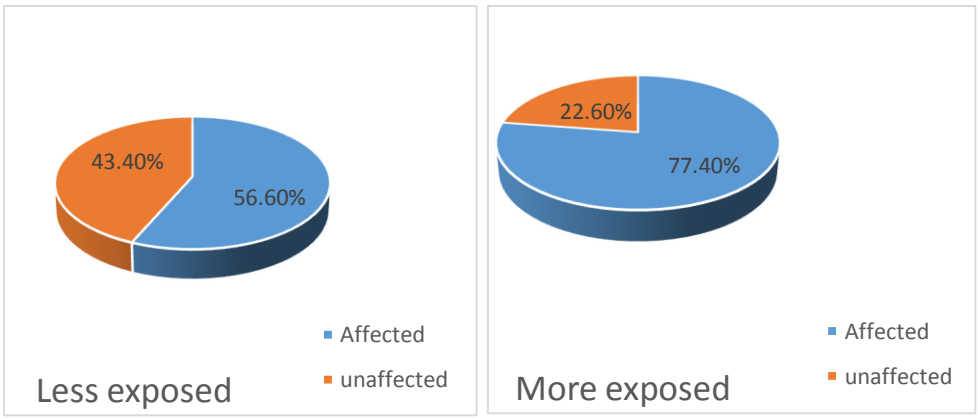



**Figure 4**: Relationship between eye disorders and degree of exposure to dust

tear film changes provided significant information in patients without evident clinical signs of an eye disease. Moreover, (Kjaergaard et al.,2004) performed a population study of eye trigeminal sensitivity, tear film stability, and conjunctival epithelium damage in a random sample of 182 non-allergic, non-smoking citizens of the Aarhus County, Denmark. The authors reported eye disorders in people subjected to high levels of exposure to dust, electrostatic fields, and dry air.

Fourty-two cases (79.24 %) of eye disorder out of 53 people in the more dusty sections compared to 27 cases (50.94 %) out of 53 people in those less dusty sections were recorded. This infers that people in more dusty environments are more exposed to eye disorders in contrast to people working in less dusty environments. The recorded disorders in the present investigation were dominated by pinguicula. Cement dust would thus be a factor triggering the occurrence of eye disorders (pinguicula and pterygium). Therefore, the role of occupation is undeniable in the occurrence of pterygium and the workers subjected to dusts are at risk (Vedy et al., 1988). From a clinical point of view, evolution of pinguiculas to pterygiums is observed. In the study of 115 cases of Cornand (Sahara), analysis of the frequency of pinguicula and pterygium shows that it is around 45 years old when the frequency of pinguicula decreases that the frequency of pterygium rise to its highest (Vedy et al., 1988). Figure 3 shows the relationship between exposure to dusts and disorders.

Thirty-seven (69.81 %) of the more exposed people complained versus 62.26 % of the less exposed people. This showed that more exposed people seem to complain more than those who are less exposed. Actually, 70 people out of 106 surveyed complained about eyes disorders. These complaints could be explained by the contact of eyes with cement. The dust of the airborne gypsum (a component of cement) can cause an immediate or delayed irritation or inflammation of the eyes and an important quantity of gypsum can cause a red patch of eyes (LNA, 2008). Figure 4 shows relationship between eye disorders and degree of exposure to dust.

Eye disorders were identified with 41 more exposed people (77.4 %) compared to 30 people (56.6 %) less exposed. The most exposed people are thus at higher risk than those who are less exposed. This finding substantiates the connection between intensity and nature of the damage and the concentration of the pollutant (dose). Actually, (Kiesswetter et al., 2005) demonstrated a strong

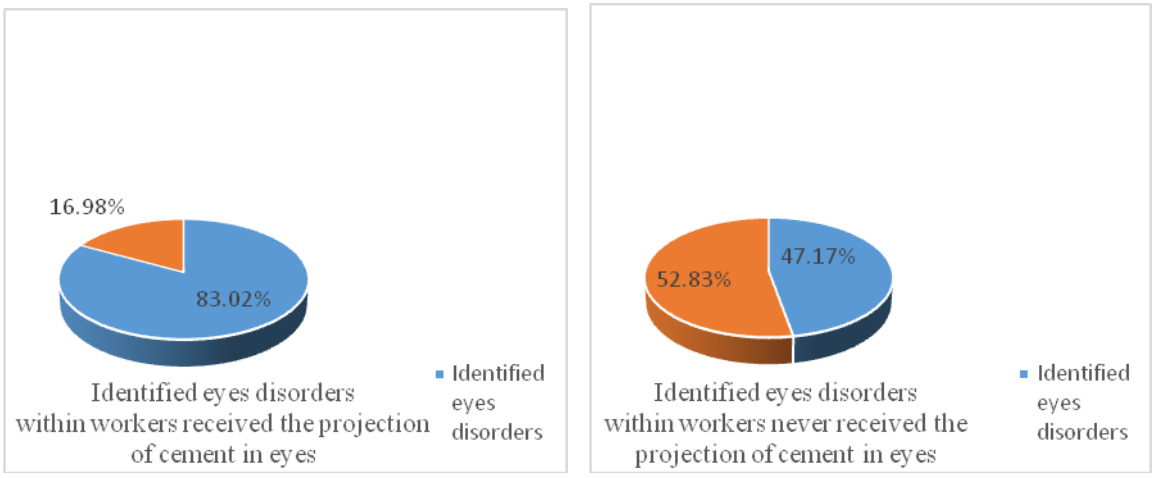



**Figure 5**: Correlation between the projection of cement in eyes and identified eyes disorders

dose-response relationship between airborne solvent concentrations and blink rates. The authors showed that during peak exposures to 40 mg kg-1 2-ethylhexanol, blink rate increased threefold. In four hours exposure, blink rate increased significantly, showing no adaptation. These results indicate that the irritative potential of 2-ethylhexanol is higher than generally expected. Figure 5 depicts the Correlation between the projection of cement in eyes and identified eyes disorders.

Eyes disorders were identified with 83.02% of workers who often received cement in eyes against 52.83% who didn't receive cement in eyes. Our results showed that the identified eye disorders were statistically connected to the frequency of cement projection in eyes. It would then represent a favouring factor that triggers eye disorders. Therefore the identified eye disorders are connected to the dusts of the cement. Studies showed that inside a cement industry, eye diseases are the most frequent (38 %) diseases of occupational origin after lung troubles (52 %) (Hossou, 1988). Crystalline silica dust can cause an irritation of eyes (Ruin et al., 2010). In the United States, the majority of the eye damages among 2000 workers on a daily basis result from small particles of object (wood, cement and metal) having entered the eyes (CDCP, 2005).

Our findings suggest an association between cement industry activities, cement dust and eye disorders. Actually, cement dust irritates the skin (Isikli et al., 2003).Its deposition causes a basic reaction leading to increased pH values that irritates the exposed mucous membranes (Zeleke et al.,2010). Various pollutants from cement industry include particulate matter (Suspended and Respirable), Nitrogen oxides, Sulphur oxides, Carbon monoxide, Volatile organic compounds (VOC) and Green House Gases (GHG) and other substances include: Acidic compounds, Heavy metals – Cadmium, Lead, Mercury and Nickel were reported Mehraj and Bhat, 2014. Remky et al.(2004) found that chronic exposure to carbon disulphide may lead to retinal vascular changes and retinopathy. Also, Andrés et al.(1988) investigated the influence of air pollution, specifically sulphur dioxide ($SO_2$), on tear pH in a random sample of 100 subjects, divided in three groups according to the stability of their precorneal tear film (PTF) (normal eyes, borderline, and dry eyes). The average pH value was 7.52. The pH for borderline and dry eyes was higher than for normal eyes. The authors found that air pollution affected the lacrimal pH, which decreased when the atmospheric $SO_2$ increased. Besides, Wolkoff et al.(2005) suggested a strong relationship between air NO and/or $NO_2$ and conjunctivitis. These authors demonstrated that acidification of tears in an atmosphere with a high oxidant power (NO, $NO_2$, $SO_2$) could thus exert irritant effect on the eye surface. Moreover, Resch et al. (2005) investigated the effect of inhaled CO on retinal and choroidal blood flow. These authors found that CO inhalation caused the widening of retinal arteries and veins independent of the significant increase of carboxyhaemoglobin. Retinal blood flow, subfoveal choroidal blood flow, and fundus pulsation amplitude increased significantly in response to CO inhalation. However, no changes in the retinal microcirculation were found in a series of fundoscopy studies which investigated the effects of sustained low-level elevations of carbon dioxide on cerebral blood flow and on the auto-regulation of intracerebral arteries in humans (Sliwka et al.,1998).

## Conclusion

The various activities of cement manufacture present risks of production of solid, liquid and gaseous residues which could be the cause of numerous diseases for the staff working in the factory and for the residential populations. However, more research in cement industry activities and occupational medicine is needed in order to improve the

understanding and diagnostic approach to ocular damage caused by environmental and occupational factors. Insights into the mechanisms of these impacts on the eye may help us develop preventive measures during the working life, not only in preventing occupational diseases, but also in using occupational surveillance to counteract ocular disability of the advanced age.

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