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Review Paper

Vulnerability of the Populations of the Fifth District of Cotonou to Sanitary Risks Related to Cement Production (Benin, West Africa)

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Abstract

Populations have lived closer industrial sites since a long time. But by the time, the coexistence of industrial sites and cities sometimes lead to major accidents with dramatic consequences. The study aims at evaluating the sanitary risks related to the production of cement by the Cements Society of Benin (SCB) on the populations of the fifth district of Cotonou. Socio-anthropogenic investigations based on individual techniques of interview and direct observation allowed to identify the sanitary risks around the cement factory. The analysis of results is done from deductive method and descriptive approach. The results revealed that around the SCB, the populations experienced some diseases like respiratory pathologies (Asthma 67%, Sharp Respiratory Infections 88%), ophthalmic infections (41%) and dermatitis (48%). Based on those results, one can say that supplementary efforts of integrated investment remain to be done by the authorities and the cements society of Benin (SCB) for a reduction of the pollution sources.

Keywords: Cotonou, Cement, Disease, Environment, Sharp Respiratory Infections.

Introduction

The environmental questions have become the daily preoccupations beyond the setting of the enterprise in regard to the evolution of the national and international legislations. From then, since years, the function "Responsible Environment" has become compulsory for a big number of enterprises[1].

The need to have an economic growth brings the developing countries to accelerate their rhythms of industrialization. That is accompanied with negative consequences on the environment and on the human health[2].

The big industrialized cities like Quebec, Hong Kong, produce every year about 3,471,000 tons of solid waste (of which 235,500 tons are industrial waste)[3] and 3,000 cubic meters of waste water, it means 50 tank-wagons[4].

China, the most populated country of the world, experiences since about fifteen years spectacular rates of industrial and economic growths. Unfortunately, this growth is also accompanied by a very strong deterioration of the environment. This deterioration sets China among the most polluted countries of the world, notably onits atmosphere[5].

As those big cities, Cotonou doesn't escape this reality of pollution. The population of Cotonou is of 678,874 inhabitants now and valued to 820.000 in 2012[6]. Cotonou includes three types of enterprises: heavy, semi-heavy and light enterprises. They participate in 13.3% to the gross domestic product (GDP)[7].

Those industrial facilities distributed almost everywhere in the city make a direct pressure on the environment depending on the nature of their activities which generate nuisances and pollutants[8]. The effects of those pollutants have negative impacts on the environment and on the health of the populations of the fifth district of Cotonou.

It is the reason why the urban environment requires a particular attention on behalf of all actors of the socio-economic life of the city of Cotonou[1].

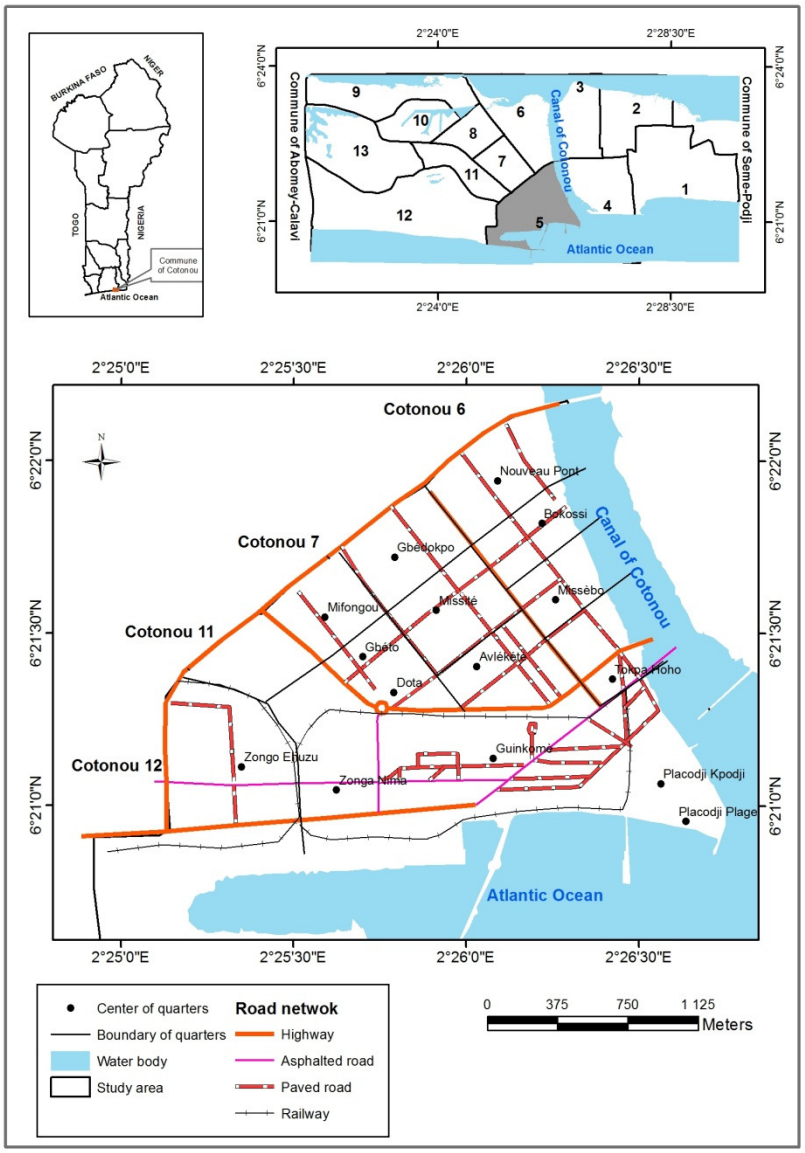
The Cements Society of Benin (SCB) situated in Xwlakodji Quarter in the 5th district began serving in 1969[9]. Placed in the center of the cement industry, it owes its existence to the operations of transformation of the raw materials (gypsum, chalky and clinker) in cement.

Since its creation, the SCB received a lot of investments for the modernization of its production tools. Thus, of an initial capacity of 225,000 tons, it is currently to a total production of 450,000 tons per year[9]. In spite of the efforts agreed by the authorities of the SCB, a major challenge remained to raise, the one of the environmental management.

In relation to this last, it is clear that the question of the management of the industrial waste produced by the factory constitutes a major preoccupation as well for the authorities of the factory that for the population of the 5th district.

Then, some actions have been undertaken by the persons responsible of the society to reduce to its maximum the insalubrity and the pollution of the environment. It is about of: the domestic and industrial waste collection; the management through the atmospheric dismissal reduction; the reduction of the resonant pollution; the liquid dismissal management in particular the oils of draining.

Considering the position of the factory (Figure-1), situated previously in a peripheral quarter (which has become populous quarter), added to the high circulation of people and goods around the factory, it appears necessary that all industrial wastes must be managed in an adequate manner to preserve the health of the users in particular and of the population in general[1]. The goal of the present survey is to apprehend the different sources of pollution, the factors of resistance in the environmental management.



Sources: IGN, 1992; Realization: SOHOUNOU M., 2016

Figure-1
Geographicsituation of the fifth district of Cotonou

Materials and Methods

The data related to that research have been collected through field investigations, field interviews and interviews with local authorities. It was about the socio-anthropogenic data obtained from the populations and resource persons. The sanitary data have been obtained from the service of statistics of the Center of Health of Cotonou I - IV.

The documentary research has been done in the centers of documentation of the Faculty of Letters, Arts and Humanities (FLASH), of the Faculty of Health Sciences (FSS) and on internet.

The reasoned choice technique has been used for the identification of interviewedpersons. These people have been identified through information received from one of the children of the Quarter chief of Xwlacodji. These people fill the criteria below: i. to have at least 18 years at the investigation moment; ii. to be a regular civil servant in the locality during the last ten years; iii. to have lived regularly in the locality during the last fifteen years.

Indeed, to understand the realities of a locality, it is necessary to have lived there during a certain number of years.

The retained quarters are those that are situated in the vicinity of the factory. Those quarters includs Tokpa-hoho, Placodji-kpodji and Placodji-Plage.

The traders and the restorers are those that reside permanently in the locality considering their activities. All those actors gave their opinion on the activities of the SCB. They also gave their opinions on the state of their environment and their health.

A total of 15 health agents, 64 inhabitants of the quarters including the resident civil servants or no, 2 local authorities have been interviewed.

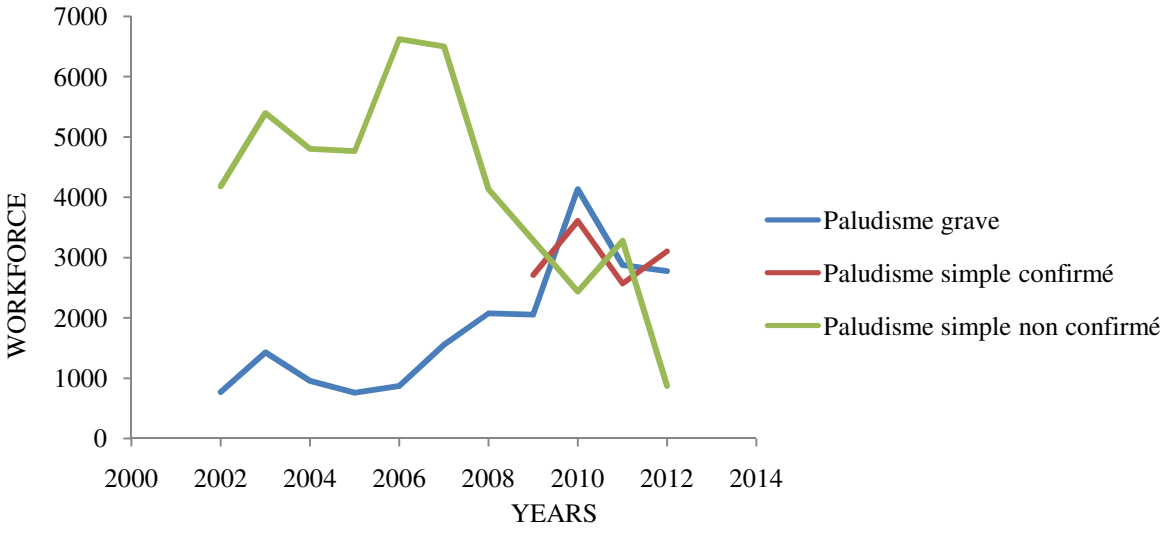
The codified questionnaires have been filled during the investigation and then stripped. The results have been integrated in the SPSS software 16.0 in order to test their significance at the 95% level.

The treatment of the data lead to the crossing of the data and the elaboration of statistical tables. It has also been proceeded to the selection of the illustrative photos of the news items, while the other figures and calculations are done thanks to the Excel software. As for the analysis of the results, it has consisted in the description, the comment and the interpretation of figures and statistical sets in order to put in relief the evolution in the space and in the time of the variables observed. The set of these works permitted to get the following results.

Results and Discussion

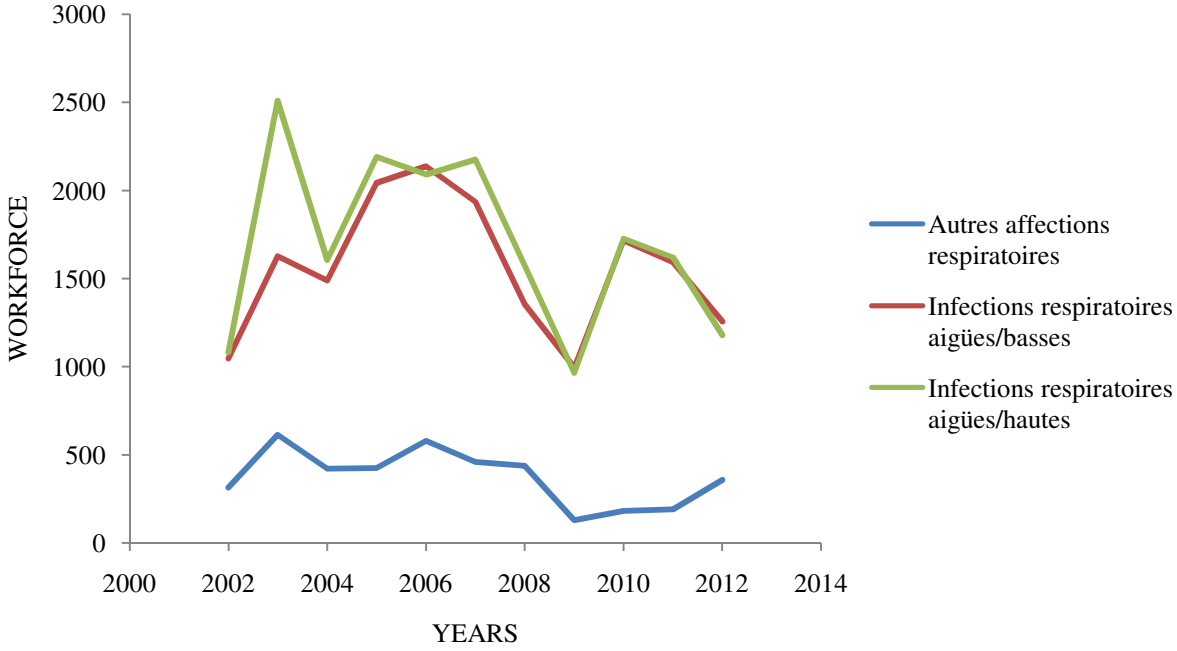
Sanitary state and pathological dynamic in the fifth district: The sanitary dynamics in the fifth district are relative to the high respiratory affections and meaningful dermatitis developed in the area.

Evolution of the pathologies around the SCB cement factory: Malaria stayed one of the first reasons of mortality in sub-Saharan Africa. In Benin, the disease rages on all the extent of the territory[10]. The evolution of the malaria, the respiratory infections, the dermatitis and the gastro-intestinal infections in the fifth district between 2002 and 2012 is illustrated on the Figure-2.



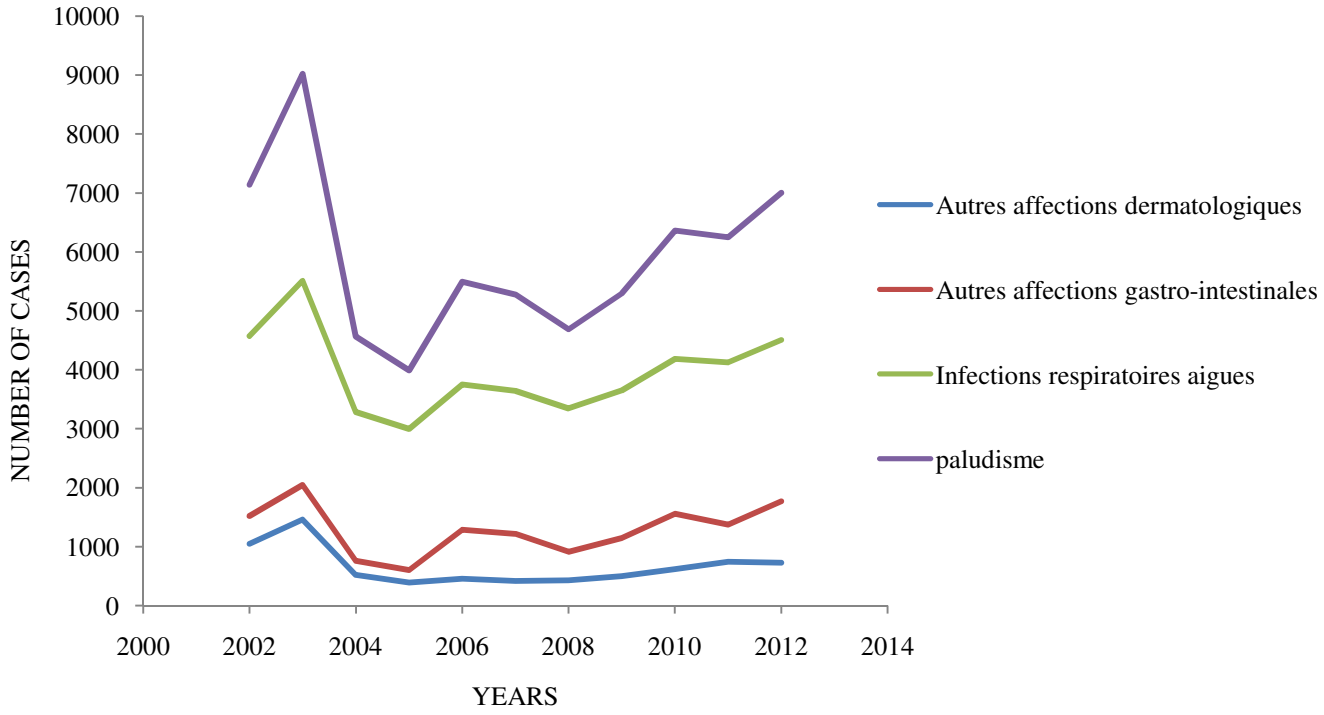
Source: Centre for health statistics of health zone of Cotonou I-IV

Figure-2(a)
Evolution of the malaria between 2002 and 2012



Source: Centre for health statistics of health zone of Cotonou I-IV

Figure- 2.b
Evolution of sharp respiratory infections between 2002 and 2012



Source: Centre for health statistics of health zone of Cotonou I-IV

Figure-2.c
Evolution of dominant pathologies

The analysis of the Figure-2a showed that the case of the simple malaria not confirmed was raised in relation to the two other. It reached its pick in 2006. This growth can be so due to the clandestine tipping of the draining oils in the gutters creating their obstructions. It would be amplified by the flooding of 2010, the year where the number of victims (serious malaria) reached its high level. The pregnant women and the children are the most vulnerable and are the most admitted in consultation.

The high sharp respiratory infections are more numerous than the two other. Those different pathologies (Figure 2.b) are certainly the most frequent due to the activities of production of the cement in the area of survey. The sparkling pollutants as the dioxide of sulfur (SO_2) and the oxide of nitrogen (NOx) are responsible for those respiratory infections. This confirms the works of Rebouh (2012). The concentrations of those pollutants trigger some broncho-spastic effects for the asthmatic, increase the sharp respiratory symptoms for the adult (cough, respiratory gene), and alter the respiratory function for the child. As for the oxides of nitrogen, they disrupt the respiratory function, while provoking chronic respiratory unrests. At high dose, they can generate some lesions. They penetrate in the finest respiratory way ramifications. They can, with 200 µg/m, drag a change of the respiratory function and a bronchial hyper-reactivity for the asthmatic and the children[11].

The dermatologic affections experienced their elevated rate in 2003. Those affections appear because of the activities of the factory from which emanate dusts and sparkling pollutants. In contrary, in other health zones, there is scarcely such affections.

The gastro-intestinal affections, from 2002 to 2012, knew a pick in 2003, fell and reached its lowest rate in 2005. Then, it began to progress slowly until 2012. This evolution is due to the increase of the productive capacity of the factory and therefore of the expansion of the dust and the sparkling pollutants[1].

The most widespread affections are sharp respiratory infections. They constitute the first reason of consultation and hospitalization in the fifth district. It really proves the impacts of the production of the cement on the state of health of the populations and on the environment. Those results are identical to those gotten by, that showed that sharp respiratory infections dominate in the same sector of survey[10].

Effects of the industrial waste of the SCB on health and model of management: The district is polluted by the atmospheric pollutants like dust, exhaust gases and volatile organic compounds. It comes out again that the dust represents more than 65% of the atmospheric pollutants found in the fifth district. The atmospheric pollutants can be classified in two groups: i. the dusts: suspended particles coming from loadings, discharges of raw materials and bagging; ii. The exhaust gases: smoke containing suspended chemical particles coming from the combustion of the hydrocarbons (diesel, gas) of trucks, heavy contraptions, generators and other engines[1].

Those pollutants, because of their chemical compositions (monoxide of carbon, oxides of nitrogen, lead, cadmium and oxides of sulfur), have the capacity to form, with the natural air, more complex compounds (dioxide of carbon, dioxide of nitrogen, dioxide of suffer, etc.) that are harmful to health. Thus, the inhabitants of the 5thdistrict of Cotonou are exposed to risks of affections such as: respiratory illnesses (rhinitis, angina, rhino-bronchitis, pulmonary embolisms, pneumonia, etc.); ocular infections; migraines; conjunctivitis; dermatitis[10].

The Table-1 and 2 present the illnesses and the atmospheric pollutants that are responsible for those affections and the effects of the pollutants on the environment.

Table- 1
The illnesses and their responsible atmospheric pollutants

Illnesses	Responsable polluants
Dermatitis	CO_2, cementdust, SO_2
Asthma	CO_2, SO_2, O_3
Chronicbronchitis	S, SO_4
Migraine	Noise
Trachoma	Dust, lack of hygiene,
Hearing affections	Noise fromengines
Conjunctivitis	All pollutants in the air
Chronicbroncho-pneumonia	Cement dust, exhaust gas, SO_2, SO_4

Source: Health Center of Xwlacodji, November 2013.

From the analysis of those 2 Tables, one concludes that in the study area, several pollutants werein the environment. Those pollutants were therefore responsible of numbers of illnesses. Also, a categorization of the pollutants has been made according to their impacts on health or on the environment.

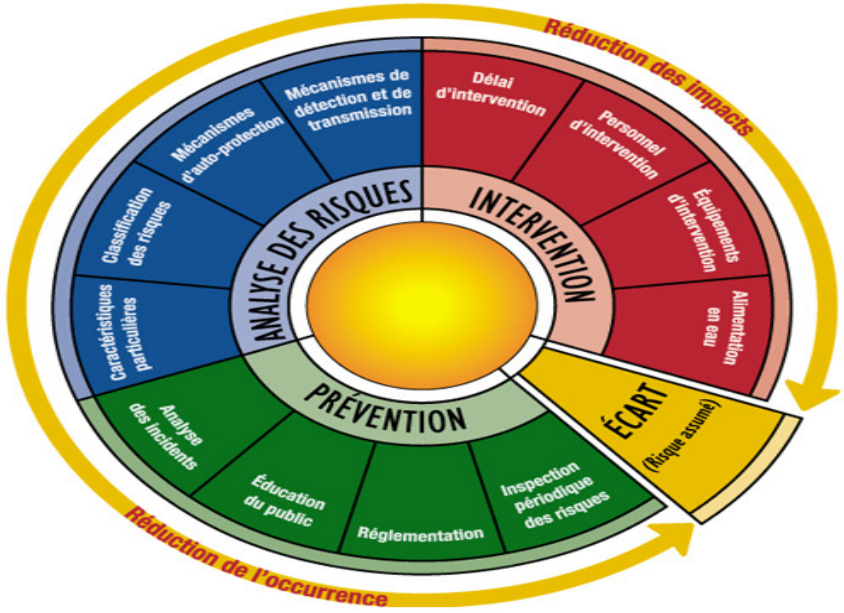
Prevention and management m**odel of sanitary risk in the fifth district of the city of Cotonou:** About industrial risks management, three phases are necessary to be known: the prevention, the analysis of the risks and the intervention. So, a model of management is then indispensable to reduce the vulnerability of the populations to the environmental and sanitary risks from the production of the cement in the fifth district of Cotonou.

The Figure-3 shows that for the reduction of the vulnerability of the populations to the sanitary risks, 3 phases are necessary. It is about the prevention, the analysis of the risks and the intervention in case of disasters. That model integrates well the management of the waste around the industries like the Cements Society of Benin.

Table-2
Effects of pollutants on the environment

Pollutants	Effects on the Environnent
Dioxide of sulfur SO_2	- In presence of water, the dioxide of sulfur forms sulphuric acid (H_2SO4) that contributes, as the ozone, to the acidification of the environment. - Acidic rain phenomenon by transformation in sulphuric acid with the contact of the air humidity. - Deterioration of the stone and materials of many buildings.
Dust or suspended particles in which PM_{10} et $PM_{2.5}$	The dusts absorb and distribute light, limiting the visibility. They cause the formation of smudge by deposit and can have an unpleasant odor.
Oxide of nitrogen (NO et NO_2)	- The oxides of nitrogen intervene in the formation of tropospheric ozone and contribute to the acidic rain phenomenon that attacks plants and buildings - Involvement to the increase of the greenhouse effect
Ozone (O_3)	In very high quantity, the ozone can have prejudicial consequences on the environment. It contributes to the acidification of the environment that disrupts the composition of air, of surface waters and soil. Thus, the ozone carries prejudice to the ecosystems (forest fading, acidification of the soft water lakes, food assembly-line disruption, etc.) and damage the buildings and the cultures
Volatileorganic compound such benzene	The volatile organic compounds intervene in the formation of tropospheric ozone and contribute to the acidic rain phenomenon that attacks plants and buildings. - Involvement to the formation of the tropospheric ozone (major role with the oxides of nitrogen) - Indirect involvement to the increase of the greenhouse effect (by intervention in mechanisms leading to the formation of gases with greenhouse effect).
Heavy metalssuch Lead (Pb), Arsenic (As), Nickel (Ni) and Cadmium (Cd)	- Contamination of soils and foods - Accumulation in the living organisms and disruption of the mechanisms and biologic balances.
Dioxide of carbon (CO_2)	The increase of the concentration in CO_2 increases appreciably the greenhouse effect and contribute to a modification of the global climate.

Source: http://www.airfobep.org/impact-pollution-vironnement.html,december 2013.



Source: http/modèle-de-gestion-risques.google, modified, december 2013

Figure-3
Prevention and management model of industrial risks proposed for the SCB in the 5th district

Suggestion addressed to the state-controlled authorities: The recommendation to be taken into account is to make efficient the decision of the Council of the Ministers in its summary N° 24/SGG/REL on June 12, 2003 that orders the relocation of this industrial unit.

Conclusion

At the end of this survey, it comes out that in the fifth district of Cotonou, the Cements Society of Benin has produced every day an enormous quantity of industrial waste through its exploitation. This causes thus a lot of nuisances to the environment and to the human health.

The atmospheric pollution is the one the environment disruption patterns which is well perceived by the citizens. These sanitary and environmental consequences are nevertheless even considerable and a lot of efforts have to be done concerning reduction and prevention, notably in the developing countries.

The atmospheric pollution under all of its types and particularly the one industrial related to the dismissals of the cement factory became one of the present human curse. That curse included illnesses related to the respiratory system (asthma, bronchitis, emphysema, cancer, etc.) to blood (anemia) to skin (allergic dermatitis), etc.. The contemporary medicine doesn't succeed in stopping them. Theoretically, if the set of arrangements are taken and works are done upstream of all industrial installation concerning cement factories in prevention of the pollution of the environment, the thousands of people will be safe from all pains generated by the activities of those factories.

The fundamental raw material that enters in the manufacture of the cement (clinker) contains lead and the cadmium too[1]. Their expansion in the environment entails very serious illnesses for the health of the populations following an exhibition for a long time. They also put an emphasis on the different pathologies developed by the populations in the district. It is fundamentally about the malaria, the sharp respiratory infections, the gastro-intestinal affections and the dermatitis.

It has been presented a model of prevention of risks and management of industrial disaster in order to avoid, and if it is impossible, to reduce notably the dismissals and their impacts on the human and the environment.

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