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TARGET CANCER RISKS DUE TO THE EXPOSURE FROM SILICA AMONG THE COMMUNITIES LIVING SURROUND CEMENT TONASA INDUSTRY PANGKEP, INDONESIA

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Abstract

The dust in lung accumulation may lead the tissue reaction to the dust known as pneumoconiosis. Several factors potentially affect the respiratory tract and impaired the function of pulmonary. The study was observational analytic and conduct a health risks assessment for target cancer risks calculation. The population in this study were communities living surround the cement industry of PT. Tonasa Pangkep. The sample in this study was accidentally random sample. Data gathered from the direct for the level of Personal Dust Sampler, questionnaires application, and ambient air analysis. The data is processed through editing, coding, processing and cleaning. The data was analysed for univariate, bivariate and multivariate tests. THQ calculation indicated that potential hazard quotient that may occur. The highest hazard was in mixed fruits (0.563) followed by traditional cake (0.478) and in drinking water (0.015). although all values were still < than 1 indicated safe, the potential hazard may occur due to the accumulation and bio-magnification process in the human body. In conclusion, most of the value of THQ still safe <1, however the ecological risks value have been > 1 indicated at risks.

Keywords: Silicosis occurrence, Silica dust, Pneumoconiosis, Surround community, living Period, Target Cancer Risks.

Introduction

Cement product of industry resulted of a blend of raw materials: limestone as the main ingredient and clay or other substitute materials with the final result in the form of powder / bulk solids, regardless of the manufacturing process, which hardens or petrifies in water mixed. Limestone / limestone is a natural material containing

Calcium Oxide (CaO) compounds, while clay / clay is a material nature which contains compounds: Silicon Dioxide (SiO_2), Aluminum Oxide (Al_2O_3), Iron Oxide (Fe_2O_3) and Magnesium Oxide (MgO). To produce cement, the raw material is burned to melt, partly to form the clinker, which is then destroyed and added with gypsum in the appropriate amount. Mengkidi, et.al., (2006).

Miner's phthisis, potter's rot, grinder's asthma are part of Silicosis, is a form of occupational lung disease leaded by inhalation of silica dust chronically and is characterized by inflammation and scar formation from upper nodular lesions of lung lobes. Silicosis is a type of pneumoconiosis. (Susanto, 2011; Greenberg, et.al, 2007; Thomas et., Al., 2010).

The most effect on the environment associated with silicon comes from the mining process. Chemicals Carbon monoxide, for example, is a by-product of the basic process by which silicon is made from silicon dioxide, but this is a negligible source of atmospheric carbon, compared to the amount produced by burning fossil fuels. Workers in mining and stone cutters have the potential and very risk of suffering from silicosis, or lung disease caused by continuous exposure to silica dust. Silica-related products are generally found in the work environment in various industries. But the majority are in the cement industry.

Some silica-containing materials include bricks, blasting abrasives, concrete, mortars, sandstone, humus, and asphalt. More prominent industries will include manufacturing, mining, agriculture and construction, just as an example. In general, according to the National Institute of Occupational Safety and Health (NIOSH), more than 1.7 million US workers are exposed to crystalline silica which is inhaled at any time when working or is within exposure.

As a human carcinogen, crystalline silica has been contributing a big number of disease among worker and communities. International Agency for Research on Cancer (Lyon, France); however, some recent research have found and have supplied quantitative data on silica exposure, silicosis, and/or smoking. Lung cancer is regarded as one of the harm consequences due to exposure from silica. a pooled analysis of 10 cohort studies (12) and concluded that "crystalline silica in the form of quartz or cristobalite dust causes cancer of the lung" (IARC, 2009)

The Cement Industry causes air pollution both inside and outside the factory environment which affects the air quality and health of the surrounding community. According to Susanto, A. D.[2]. Various disorders of the respiratory system and lung disease in the community as well as workers occur due to the high concentration of dust particles, or smoke arising from the cement processing in the industry. Pneumoconiosis as a result of mineral dust inhalation is a group of serious both community and occupational diseases and lead reaction of lung tissue, which eventually induce irreversible lung damage.

The most common types of pneumoconiosis include silicosis, cements and coal workers' pneumoconiosis and communities living surround pneumoconiosis, (Pascolo, et.,al.,2015). Those fact, emphasize the necessity to conduct this research as

main advocacy data for stakeholders to minimize the health and ecological risks effect to communities living surround the factory.

MATERIALS AND METHODS

Materials and research design

This type of research is analytic observational research, using quantitative approaches and cross sectional research designs. The purpose of this study is to find out the relationship between the independent variable and the dependent variable. The population in this study is the people who live around the Semen Tonasa Plant. The sample in this study amounted to 50 people. Data were collected using a questionnaire given to respondents, measurement of dust exposure, measurement of lung vital capacity, and direct observation. Analysis of the data used in the form of univariate and bivariate analysis using chi square test.

Dust Rate Measurement in the Air

Measurement of dust levels in the air aims to determine whether the levels dust in an environment, in this case in the surround cement plant in the communities area. The concentration is in accordance with environmental conditions whether safe and healthy for the community. In other words, what is the dust level is below or above the threshold value (NAV) of air dust. Intake/measurement of dust levels in the air is usually done with gravimetric method, which is by sucking and passing air in a certain volume through a glass fiber filter / filter paper. The usual tools used for total dust sampling (TSP) in the air.

Silica Concentration in Personal Air Dust Sampler

The concentration of silica in the air is the amount of silica content contained in the air. The silica concentration was obtained from ambient air sampling in the form of Total Suspended Particulate (TSP) at seven points scattered in the area of Biringere Village. The TSP sample was taken using the High Volume Air Sampler (HVAS) tool with the grab sample method or a one-hour sample at each point in the afternoon until the afternoon. TSP stored in filter paper media is brought to the laboratory for testing.

This tool is commonly used to determine Respiral Dust (RD) in the air or dust that can escape through the human nose hair filter during breathing. For a flow rate of 2 liters / minute it can capture dust measuring <10 microns. This tool is usually used in the work environment and mounted on the waist of workers because of its very small size.

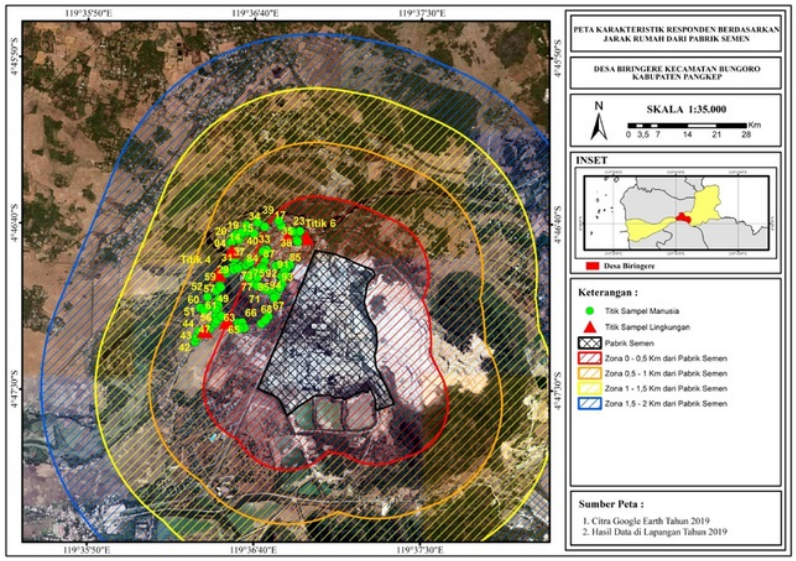

Figure 1 shows a cement factory marked with a black zone, while the respondent's houses are in the red to orange zone which is 0-0.5 km from the cement factory and 0.5-1 km from the cement factory. This condition is not in accordance with the Regulation of the Minister of Industry No. 40 of 2016 which stipulates that ideally the distance from settlements is at least 2 kilometers from the location of industrial activities. This means that settlements should be outside the blue zone.

Determination of Ambient Air Sampling Location and Sampling Points

In general, ambient air samples are taken in residential areas, offices, industrial areas, or other areas that are considered important. The purpose is to find out the air quality that can be affected by activities certain. Criteria that can be considered in determining the location of collection ambient air samples, namely: Areas that have high pollutant concentrations, densely populated areas, Areas that are expected to receive pollutant exposure from chimney emissions industry, and Projection area to determine the impact of development In addition, meteorological factors, such as wind direction, wind speed, temperature air, humidity, and geographic factors, such as topography and land use, must be considered. Some references in determining the point of taking (Hadi, 2005)

RESULTS

Concentration of silica in well water, river water, sediment surface soil and air particulate

TABLE 1. CONCENTRATION OF SILICA (SIO_2) IN WELL WATER, RIVER WATER, SEDIMENT SURFACE SOIL AND AIR PARTICULATE AROUND THE TONASA CEMENT INDUSTRY PANGKEP, INDONESIA

Station	Concentration of Silica (SiO_2)				
	Well water	River water	Sediment	Surface Soil	Air particulate
1	11.24 mg/l	7.10 mg/l	25.35 mg/l	2,78%	1.12,%
2	12.12 mg/l	8.01 mg/l	22.43 mg/l	3,28%	0.99%
3	9.03 mg/l	7.26 mg/l	29.13 mg/l	6,34%	0.89%
4	10.11mg/l	18.12 mg/l	41.11mg/l	5,52%	1,01%
5	14.18 mg/l	7.12 mg/l	15.18 mg/l	3,32%	1,18%
6	11.22 mg/l	6.17 mg/l	19.83 mg/l	2,31%	2,23%
7	13.14 mg/l	8.32 mg/l	22.73 mg/l	3,43%	1.33%
8	16.18 mg/l	11.42 mg/l	39.31mg/l	4,32%	2.19%
9	12.12 mg/l	9.44 mg/l	22.23 mg/l	8,12%	2.74%
10	13.96 mg/l	12.17mg/l	31.14 mg/l	7,92%	1.18%

Table 1 show the highest concentration of Silica (SiO_2) around the Tonasa Cement Industry Pangkep on well water with (16.18 mg/l), river water (18.12 mg/), sediment (41.11mg/l), surface soil (7,92%) and air particulate (2.74%), respectively. The magnitude of Silica level was in sediment > river water > well water > surface soil > air particulate, respectively.

3.2 Concentration of Silica (SiO_2) on traditional cake and drinking water and mixed fruits

TABLE 2. CONCENTRATION OF SILICA (SIO_2) ON TRADITIONAL CAKE AND DRINKING WATER AND MIXED FRUITS AROUND THE TONASA CEMENT INDUSTRY PANGKEP, INDONESIA

Stations	Concentration of Silica (SiO_2)		
	Traditional cake	Drinking water	Mixed Fruits
I	1.10 mg/l	0.20 mg/l	7.10 mg/l
2	1.01 mg/l	0.31 mg/l	8.01 mg/l
3	2.26 mg/l	0.26 mg/l	7.26 mg/l
4	2.12 mg/l	0.17 mg/l	11.10 mg/l
5	0.12 mg/l	0.32 mg/l	7.12 mg/l
6	1.10 mg/l	0.10 mg/l	5.39 mg/l
7	1.01 mg/l	0.08 mg/l	9.01 mg/l
8	7.26 mg/l	0.16 mg/l	8.26 mg/l
9	2.12 mg/l	0.48 mg/l	14.17 mg/l
10	1.12 mg/l	0.52 mg/l	6.16 mg/l

Table 2 show the highest concentration of Silica (SiO_2) around the Tonasa Cement Industry Pangkep on mixed fruits with (14.17mg/l), followed by traditional cake (7.26 mg/), and drinking water with (0.52mg/l), respectively. The magnitude of silica level was in mixed fruits > traditional cake > drinking water, respectively.

3.3 Target Hazard Quotient (THQ) of traditional cake and drinking water and mixed fruits

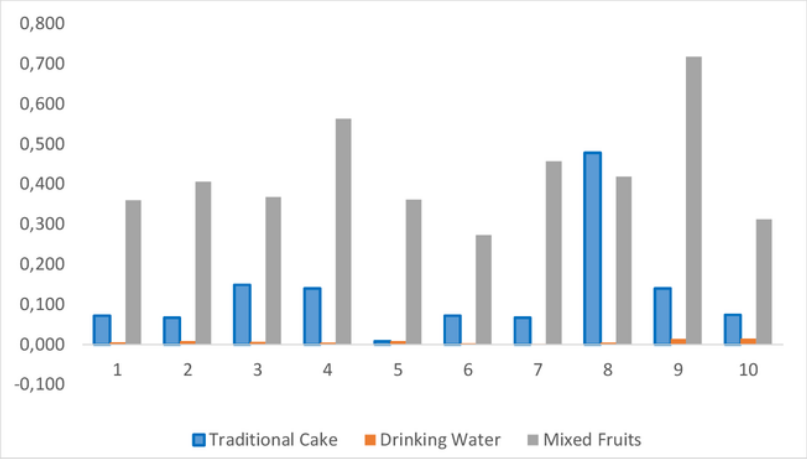

Figure 1 show the results of THQ calculation that indicated potential hazard quotient that may occur. The highest hazard was in mixed fruits (0.563) followed by traditional cake (0.478) and in drinking water (0.015). although all values were still < than 1 indicated safe, the potential hazard may occur due to the accumulation and bio-magnification process in the human body.

Discussion

The effects of air pollution on human life can be divided into general effects, effects on ecosystems, effects on health, effects on the growth of plants and animals, effects on weather and climate, and effects on socio-economics. (Sun et.al., 2011).

This disease is caused by pollution of free silica dust, in the form of SiO2 which is sucked into the lungs and then settles. Silica dust this is widely available in the steel industry, ceramics, concrete casting, process machining like grinding, grinding. Besides that, silica dust too found in iron ore mining, tin mining and coal mining. Silica dust that enters the lungs will experience an incubation period around 2 to 4 years (Wardhana, 2001).

Silica in well water, river water, sediment, surface soil and air particulate

This research found that the magnitude concentration of Silica around the Tonasa Cement Industry Pangkep on well water were 16.18 mg/l, river water 18.12 mg/, sediment 41.11mg/l, surface soil 7,92% and air particulate 2.74%, respectively. The concentration level of Silica level was in sediment > river water > well water > surface soil > air particulate, respectively.

Silica present in drinking water may be protective with respect to the decrease of cognitive function as it was suggested by several epidemiologic studies. It has been shown that the performances to a cognitive test were positively correlated to the consumption of silica and that the risk of Alzheimer's disease (AD) was reduced in subjects who had the higher daily silica intake compared to the others. (Guyonnet, et.al. 2007).

According to Rondeau, et.,al, An increase of 10 mg/day in silica intake was associated with a reduced risk of dementia (adjusted relative risk =0.89, P=0.036). Sedimentary silica enters into the development of authigenic quartz and silicates, into clay minerals, and into other secondary compounds as a result of geochemical action.

The finding explored that in this area many biogenic silica in the sedimentary record resulted from sponge spicules rather than diatoms during the period when the surface of sea was covered by the Larsen ice shelf. Since the collapse of the ice shelf, the over growth of phytoplankton blooms and the consequent influx of diatom debris to the seabed have shifted the biogenic silica record to one dominated by diatom debris, as it was happened in the sediment of Antarctic marine. (Elisabet Sañé, et.al, 2013).

Silica (SiO_2) on traditional cake and drinking water and mixed fruits

The cement industry has the potential as a source of particle pollution (Hasibuan). Cement dust is classified into 2 (two) main types, natural cement and artificial (Portland) cement. Portland cement is a mixture of calcium oxide (62%-66%), silicon oxide (19% -22%), aluminum trioxide (4% -8%), iron oxide (2%-5%) and magnesium oxide (1% -2%). Cement dust has an irritating effect on the skin, eye and respiratory system. The type of particles (dust) produced by cement industries / factories include Silica Oxide (SiO2), Alumina Oxide (Al2O3), Magnesium Oxide (MgO), and Tricalcium Silicate (3CaOSiO2). Types of cement dust and health problems, namely: Silica Oxide (SiO2) Free silica, in the form of SiO2 which is sucked into the lungs and then precipitated to cause silicosis (Sunu, 2001);GBD 2013; and Han et.al., 2019 .

At first, silicosis is characterized by shortness of breath accompanied by coughing without phlegm. Silicosis disease is moderate, symptoms of shortness of breath and coughing increasingly high level of intensity. For already severe silicosis, shortness of breath will get worse and then followed by right heart hypertrophy which has the potential to cause heart failure (Sunu, 2001).

Target Hazard Quotient (THQ) of traditional cake and drinking water and mixed fruits

Figure 1 show the results of THQ calculation that indicated potential hazard quotient that may occur. The highest hazard was in mixed fruits (0.563) followed by traditional cake (0.478) and in drinking water (0.015). although all values were still < than 1 indicated safe, the potential hazard may occur due to the accumulation and bio-magnification process in the human body.

Conclusion

The value of THQ result calculation indicated potential hazard that may occur. The highest hazard was in mixed fruits (0.563) followed by traditional cake (0.478) and in drinking water (0.015). Although all values were still < than 1 indicated safe, however the potential hazard may occur due to the accumulation and bio-magnification process in the human body during the long period of exposure. Further, the ecological risks of silica have a high risks, the highest risks value were in surface soil with 10.15 then followed by on air particulate with 9.13 and river water 9.06, respectively.

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Ethical Clearance: Obtained from the faculty of Public health ethical clearance committee.

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