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[SHORT NOTE]

Measurement of total mercury concentration in the water source pool of public drink water installations around Manado City, north Sulawesi, Indonesia

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Artisanal gold mining activities in Talawaan Watershed of Indonesia use a large amount of mercury to form an amalgam with the gold particles. Those activities are obviously playing an important role in emitting mercury to aquatic and terrestrial environment around gold mining areas. The mine activities effectively start in 1998, but information on mercury impact to the community drink water sources is very limited. In the present study, all water sources of public drink water installations around Manado City were examined in November 2000 and in May 2001. As a result, total mercury content in all water samples of year 2000 were in the range 0.05–0.13 μg/l. In fact, those level were quite low compare to the health standard level for water (1 μg/l) established by the World Health Organization and adopted by Indonesian Government. In year 2001 or about six months after the first survey, a very different picture was observed at two drink water installations. While the total mercury contents at the other installations fluctuate around the background level, the two installations which located closer to the mining area shown a considerably increment (5 and 18 times). In spite of their values that still lower than the health standard level, those increasing trends should be considered as a glance of future potential mercury impact to the health of Manado City community. This results delight the urgently needs of better and regular quality control test on mercury level of the drink water installations especially to the sites in Talawaan Watershed.

Key words: total mercury, drink water, artisanal gold mine, Indonesia

INTRODUCTION

Economy expands through production activity cause various types of pollution, which threats environment and human health. A relative high gold deposit has advantaged North Sulawesi Province of Indonesia. A large amount of metallic mercury where use to amalgamate the fine gold particles of broken ore at artisanal gold mining processing plants in Talawaan Watershed. Emission of metallic mercury into watercourses during amalgamation process will scatter throughout river system with a very irregularly distribution. As pointed in Carmous et al. (2001) that because of its high-density liquid, mercury tends to rapidly settles and turns into anoxic condition in sediment. On the other hand, mercury also tends to be absorbed to clayey materials and organic substances, thus raising its possibility to be transported and dispersed particularly in the river with strong flow volume. The accumulate mercury in sediment was reached to acute levels of WHO (1989) in some places within the watershed and provides an increasing trend of mercury level in biological samples (Limbong et al. 2003).

Location of the gold mining area is very close to Manado City, the capital of North Sulawesi Province. The artisanal gold processing plants are dispersed far enough from mining area because there is no clear local government policy regulating the construction of the artisanal gold processing plants at any given location. Drink water supply for the city mostly provided by public drink water company. Water source installations of the company are scatter around the city. Three of those installations are located within Talawaan Watershed (Fig. 1), one of them is a deep well and the other two use surface stream. This fact elevates concern over the potential for mercury contamination of those water sources.

Little information is available on the effects of the mercury pollution to the water supply installations. The company does take quality control test on the input water, but not on regular basis, and mercury has not been included in the test parameters. Accordingly, the present study examined the potential mercury contamination to those drink water sources that may affect as many as five thousand people in Manado City.

MATERIALS AND METHODS

Water samples were collected from ten sites of public drink water installations around Manado City. Based on their water source, those installations can be categorized into water spring, deep well, and surface stream. Locations of the installations are mapped in Fig. 1. In the installation number 5, the water come from two sources, surface stream and water spring. Therefore, in total there are 11 water samples had been collected (3 from water spring, 1 from deep well, and 7 from surface stream).

Sample collections were conducted two times; the first

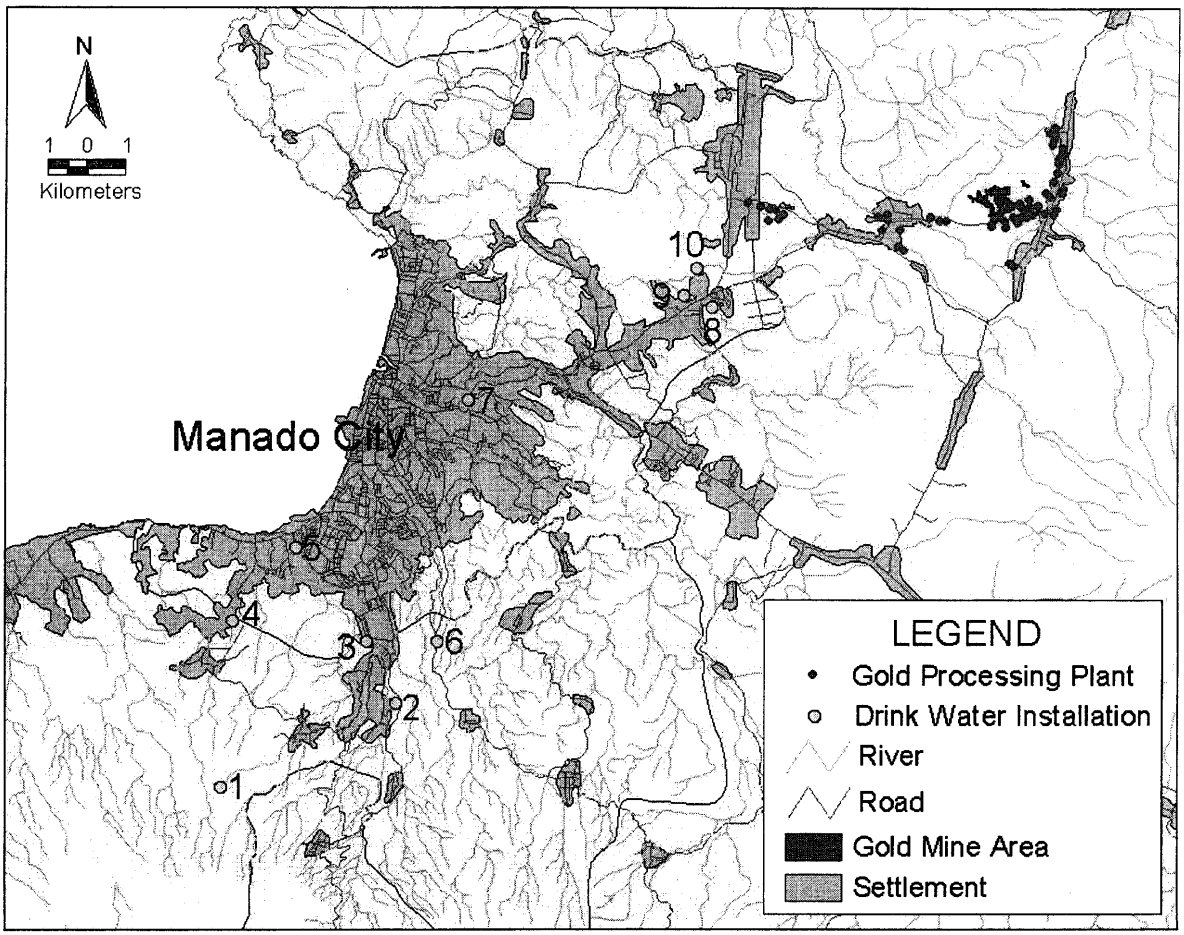

Fig. 1. Sampling sites in the Talawaan Watershed, North Sulawesi Island, Indonesia.

was in November 6–9, 2000 and the last in May 4–12, 2001. Water samples were taken from upper layer (about 10 cm from surface) of the water source pool. A pre-labeled 500 ml plastic bottle sample was used. About 2 ml of HNO_3 was added into bottle sample before its cap was inserted in order to stabilize the mercury content, because trace mercury in water sample is relatively stable at lower pH (Anonymous 2001). In the year 2001, water sample collection was also conducted for suspended solid measurement. All water samples were keep in cool box to maintain low temperature (5–10°C) during transportation to the Laboratory of Environmental Analysis, Bogor, Indonesia for mercury analysis. At the same time as the sample collection, direct measurement of water temperature and pH were carried out at every sampling site using water thermometer and pH test kit.

In the present study, the determination of total mercury was made with sensitive and reliable methods employed by the laboratory in Bogor. The analytical procedures for mercury in water samples followed those described by Daniel et al. (2003). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride before reduction of the sample with stannous choride. The mercury vapor released is then measured in a modified cold vapor atomic absorption spectrophotometer (CVAAS).

Total suspended solid is water parameter that measures the portion of solid matter that trapped by a filter. Suspended solid includes anything from silt and plankton, to industrial wastes and sewage. A 500 ml water sample from each sampling site was filtered through a preweighed 0.45 μm filter paper by using a filtration apparatus with aspirator. The residue retained on the filter was dried at 70°C for about 6 hours to a constant weight. The increase in the weight of the filter represents the total suspended solid.

RESULTS AND DISCUSSION

The results of water samples analysis are given in Table 1. For a better interpretation values of total suspended solid and total mercury content in water samples are plotted according its location in Fig. 2. The fluctuation of values of total suspended solid in water samples provides an insight that the sites use surface stream are generally deal with problem of high level suspended solid.

The results of total mercury content in year 2000 are generally low, indicate that no mercury contamination in all sampling sites. All values are far below the standard level for drink water of 1 μg/l that established by the World Health Organization and adopted by Indonesian Government (WHO, 1989). The values are indicating the background level of mercury in the study area, which have mean value of 0.096 μg/l.

In year 2001, all values fluctuate around the expected background level except values of sites 8 and 10 (Fig. 2). Although the values of the two sites still below the standard level, but the incredible increase of mercury levels within six months interval would gives an important glance. With a limited data, it is still difficult to predict with confidence the potential future increasing of mercury level in the two

Table 1. Total mercury concentration and other parameters of water samples from source pool of public drink water installations.

No.	Site name	Type	Year 2000			Year 2001			
			°C	pH	Hg (μg/l)	°C	pH	Hg (μg/l)	SS (10^{-5} g/ml)
1	Kumahukur	Water spring	25	6	0.13	25	6	0.05	0.00
2	Lotta	Surface stream	27	7	NA	28	7	0.06	1.75
3	Pancuran IX	Surface stream	29	6	0.10	28	7	0.05	1.25
4	Sea	Surface stream	28	6	0.09	28	6	0.09	1.25
5a	Malalayang	Water spring	27	6	0.09	27	6	0.05	0.25
5b	Malalayang	Surface stream	28	6	0.10	27	6	0.05	1.00
6	Koka	Water spring	26	6	0.13	27	6	0.05	0.25
7	Paal II	Surface stream	28	6	0.07	28	7	0.11	3.50
8	Perumnas	Surface stream	28	7	0.10	28	6	0.56	1.25
9	Paniki	Deep well	36	7	0.10	35	7	0.09	1.50
10	Kilu	Surface stream	27	6	0.05	28	6	0.92	1.75

NA=Under repairing; SS=Suspended solid.

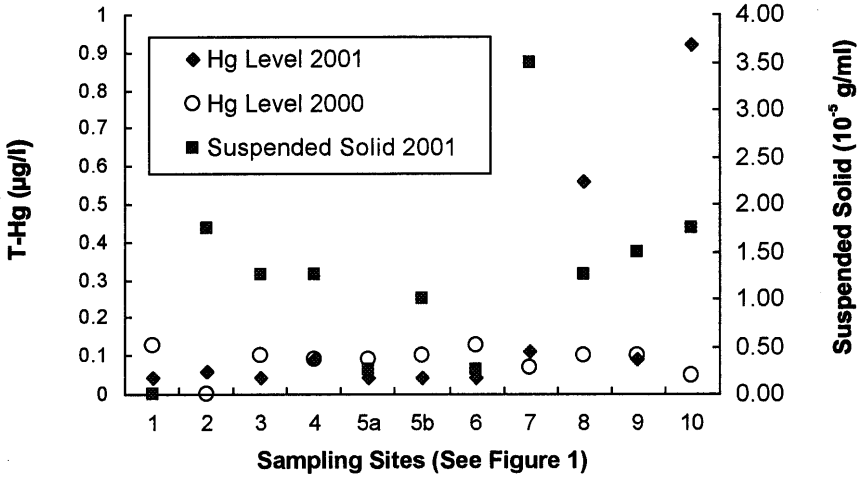

Fig. 2. Total mercury concentration and total suspended solid in water samples from source pool of public drink water installations.

sites, but these divergences suggest the potential impact of gold mining activities to water system within Talawaan Watershed because the two sites located within the watershed and use surface stream as their water source. The explanation for the low mercury level at another one installation that located in the watershed (site 9 in Fig. 1) would lie on its water source, which comes from deep well. This installation also has a unique characteristic where its water temperature fluctuates in the range 35–36°C, indicate that the water comes from a hot spring.

This results delight the urgently needs of better and regular quality control test on mercury level of the drink water installations especially to the sites in Talawaan Watershed. Special attention should consequently given to this very active mining area, solutions must be provided as soon as possible to avoid a future epidemic situation upon the continuing discharge of mercury from the artisan gold mining activities.

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