Addressing environmental and health problems caused by mercury in artisanal gold mining

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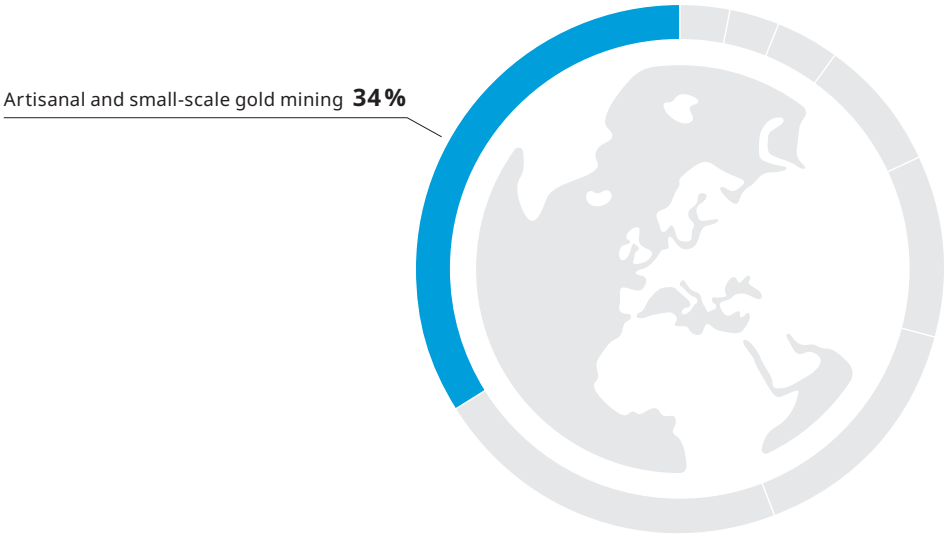

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LUMEX

Anthropogenic mercury emissions pollute the air, soil, and water and lead to severe problems with the human health. The World Health Organization considers that

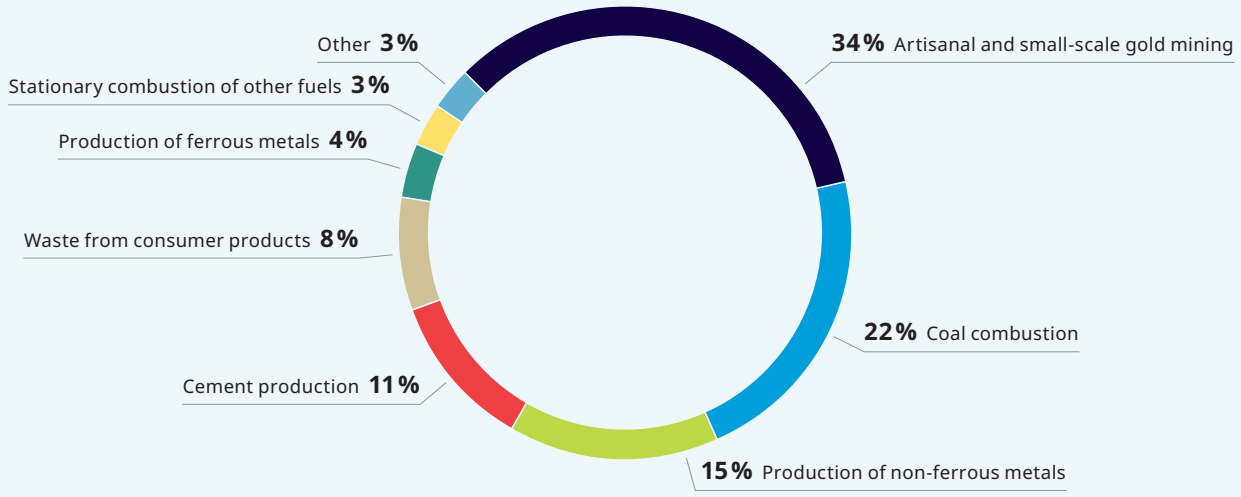
"mercury is one of the top ten chemicals of major public health concern".

ASGM is the largest source of mercury pollution

The largest source of anthropogenic mercury emissions is artisanal and small-scale gold mining (ASGM). Huge amount of metal mercury is used for gold extraction by amalgamation.

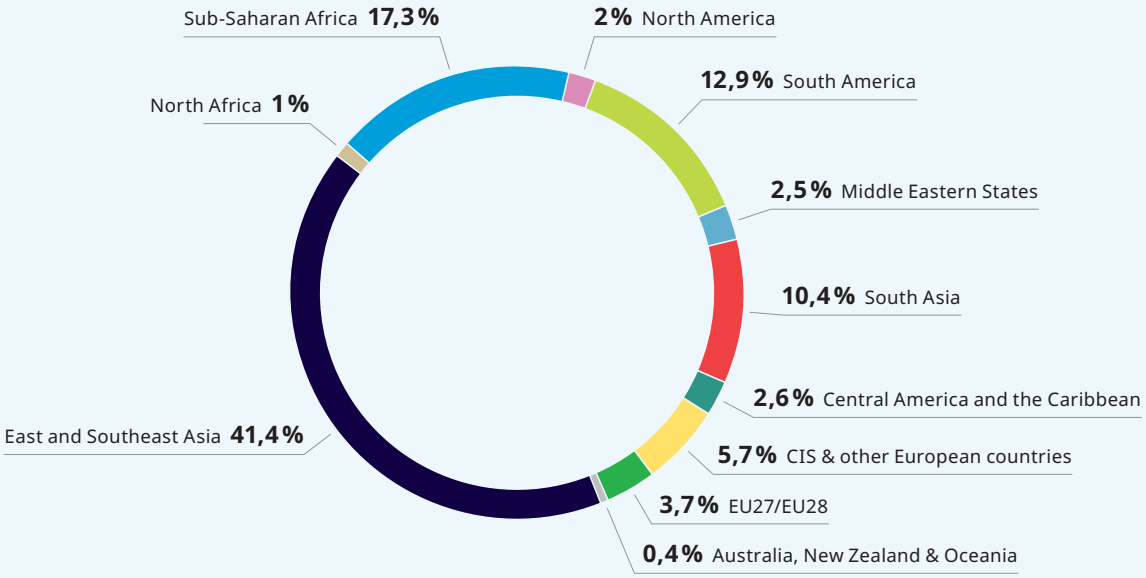
ASGM caused about 33,8 % of global emissions and 71 % of Latin America emissions of mercury in 2015 according to the draft version of Chapter 2 in the Technical Background Report to the Global Mercury Assessment 2018.

DISTRIBUTION OF GLOBAL EMISSIONS OF MERCURY IN 2015



SOURCE: *draft version of Chapter 2 in the Technical Background Report to the Global Mercury Assessment 2018.*

DISTRIBUTION OF EMISSIONS OF MERCURY BY REGIONS IN 2015



SOURCE: *"The Minamata Convention on Mercury and its implementation in the Latin America and Caribbean Region" by Basel Convention Coordinating Centre, the Stockholm Convention Regional Centre for Latin America and the Caribbean, based in Uruguay, within the framework of an agreement with the United Nations Environment Programme/Regional Office for Latin America and the Caribbean (UNEP/ROLAC).*

In more than 70 countries of Latin America, Africa, and South-East Asia artisanal gold mining is a traditional employment passed on from generation to generation. Most miners are men, women or children of poor peasants. UNIDO assesses that about 50 million people are directly and indirectly involved in artisanal gold mining. Often, these categories of people are not able to have a safer method of income. One of the most frequently used methods of artisanal gold mining is adding metal mercury to gold-bearing rocks and sediments to extract fine gold particles by amalgamation. Then the amalgam is heated to evaporate mercury and to get gold. This involves the indiscriminate use of mercury and causes the intoxication of the organisms of the miners, their families, neighbours, and also pollution of the aquatic biota, soils, etc. In contaminated sites, metallic mercury can be transformed into its most toxic form, methylmercury.

According to the report of the International Institute for Environment and Development, artisanal and small-scale mining also involves the employment of a large number of children. This topic has received international attention in the 90s after the media coverage on child labour in mines in Colombia (Hentschel et al., 2001). Children whose body has not yet been formed are subjected to a much higher risk to health than adults. (pubs.iied.org/pdfs/G00687.pdf p. 6)

The artisanal and small-scale gold mining is practiced in at least a dozen countries in the region, mainly in the andean-amazonian countries and the Amazon basin, but also in Central America; at least 500 000 artisanal miners are involved in this activity.

This sector has a significant impact on the current demand and trade of mercury in the region.

In some regions, gold mining leads to threatening levels of mercury pollution, e. g., notorious region Madre de Dios in Peru. Tests provided by Ministry of Health (www.minsa.gob.pe) in 2015 have produced alarming results on the levels of mercury contamination for 11 districts in Madre de Dios. Technical Report No. 00008-2016-Indeci/11.0 (May 17, 2016) confirmed that mercury levels in human tissues exceeded the maximum permissible limits. Therefore, the Executive has been in need of declaring in the emergency for 60 days.

The united action to fight mercury pollution

The contamination from metallic mercury and methylmercury must be monitored and eliminated. This is not an easy task, and many countries are struggling to put an end to the harmful effects caused by the artisanal gold miners and to protect those involved in the activity. One of the key events for mercury pollution response is the Minamata Convention (www.mercuryconvention.org). It was adopted in October 2013, entered into force on August 16, 2017, and by January 2018 was ratified by 85 countries. The convention aims to prevent the threats from mercury contamination. It establishes controls on import, export, and uses of mercury.

Each Party shall control emissions, develop strategies for identifying contaminated territories, develop and implement a national action plan and submit it to the Secretariat within three years after the entry into force of the Convention.

Some of the highlights of the Minamata Convention include a ban on new mercury mines, the phase-out of existing ones, control measures on air emissions, and the international regulation of the informal sector for artisanal and small-scale gold mining.

How Minamata convention influences Latin America

Many countries in Latin America already ratified the Minamata Convention: Argentina, Bolivia, Brazil, Ecuador, Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Panama, Peru, and Uruguay.

Furthermore, several countries in Latin America already developed legislation for mercury control. Colombia adopted the Law 1658/2013 that regulates the trade and use of mercury for industrial use, Ecuador Zero Mercury Plan (2013) shall eliminate the use of mercury, Brazilian Decree 97.507 (1989) establishes a range of controls. In Peru, the Ministry of Environment (MINAM) has published a supreme decree (No. 010-2016-MINAM) approving the Multisectoral Action Plan that establishes a roadmap to properly manage, reduce or eliminate the use of mercury within the major sectors in Peru.

The Minamata Convention shall tighten regulation for mercury use and trade. Therefore the access to mercury traders for artisanal miners will become more complicated.

For an adequate response, the right instrument is essential to determine mercury

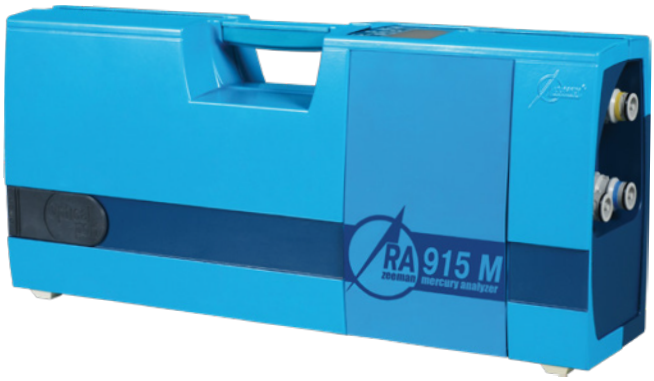
There are several analytical challenges in mercury determination.

1. The first challenge is that often the requirement is to control various media: air, water, soil, sediments, biota, and humans. Mercury concentration can vary from ppb to ppm level. To get reliable data, one needs a very wide measuring range. In the case of a sample with unknown Hg concentration, you want to be sure that you measure the right concentration covered by the calibration range.
2. Another challenge is the complex matrices. They might contain various organic and inorganic compounds, which might influence the result as well.
3. Another point is that we do not want any sample pre-treatment. Firstly, because it takes a lot of time. And the second reason is that each step you take in the pre-treatment process is a source of mistakes. Therefore, our goal is just to take the sample as is and bring it in the detector.
4. Finally, cost efficiency is crucial. For example, instruments that use the gold traps require constant checks, calibration, and replacement of those traps, and they are quite expensive. In addition, some instruments call for pre-treatment or use of carrier gases like oxygen or argon which also adds on cost.

The mercury analyzer RA-915M by Lumex Instruments covers the full range of applications required for locate the contaminated sites and assess the negative mercury impact to environment and population in the areas of ASGM. It is a portable analytical instrument for the real-time detection of mercury in air, water, natural and stack gases, oil and condensate, soil and sediments, foodstuff and human body (urine, blood, hair, exhaled air).

Zeeman background correction eliminates the effect of interfering impurities. It is the only high sensitive and selective instrument that does not require gold amalgam pre-concentration and subsequent regeneration steps.

Being combined with an RP-92 Cold Vapor accessory for water and PYRO-915+ pyrolysis attachment for solid and liquid (including oil) sample testing, the instrument is designed to determine mercury content in ambient air, water, soil, natural and stack gases. It can be used in dental industry and medical testing and diagnostics, analysis of food and seafood, etc., the mercury detection limits being as low as 0.5 ng/m^3 in air and 0.5 ng/l in water.



Lumex mercury analyzers are widely used for assessment of mercury pollution in areas of ASGM. UNIDO team applied them for field and laboratory measurements in a frame of Global Mercury Project (www.unido.org/mercury-programme)

- Watch the webinar: Mercurio en mineria de oro
- Watch the webinar: Simple mercury analysis of complex samples: soil, oil, foodstuffs, and more
- Download: Rapid analysis of total mercury in waste waters and process waters with elevated mercury content using direct pyrolysis technique
- Download: Direct determination of mercury content in ambient air
- Download: Determination of a total mercury content in urine
- Download: Direct atomic absorption mercury determination in tissues and biological samples