Reduce mercury vapor exposures at the source in small scale gold mining. Another golden opportunity.

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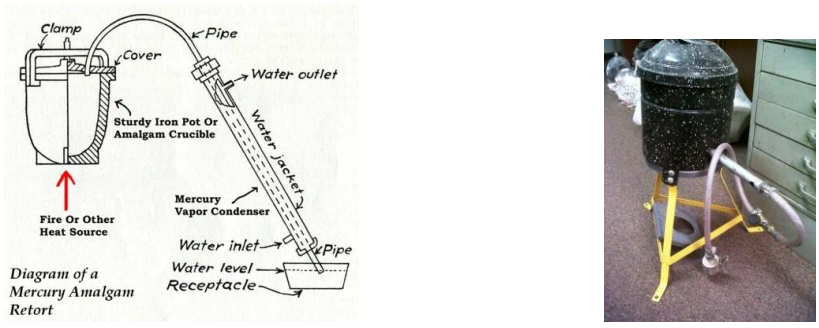
Background

This proposal describes the goals, relevance and methodology of a project to design and implement retorts (recycling mechanisms) aimed at reducing mercury emissions from small-scale gold mining in Suriname, South America. Worldwide 15 million men, women and children are working in artisanal and small-scale gold mining (ASGM), representing 90 percent of the global gold mining work force. While ASGM provides a livelihood for more than 100 million rural poor it also has many undesirable side effects, including the use of mercury. In ASGM amalgamation is used to recuperate gold from ore. Eliminating mercury from the small-scale gold mining process is important because it is worldwide the primary anthropogenic source of mercury emissions. On the long run the Suriname government is determined to completely phase out the use of mercury in mining and ratify the Minamata treaty (http://www.mercuryconvention.org/. However, some stakeholders agree that it is not realistic to completely phase out mercury in short-term.

The current practice is that the ore is mixed with mercury for extraction of gold from the ore. A key step in the process of gold mining is the evaporation of mercury from amalgam. Mercury evaporates when it is heated, either over an open fire or using a gas burner, by a person who is virtually unprotected. The environmental pollution causes exposure of local inhabitants due to consumption of fresh water fish with too high methylmercury values (Ouboter et al., 2012). Recovery of most of the mercury can be achieved by use of a so-called retort (Figure 1). Recent studies showed that only 8.8 % of the responding miners are always using a retort (Duijves and Heemskerk, 2014). More than 30 % of the miners have never heard of this solution. The main reason for not using a retort is that it is not available. Some miners who tried the retort report that the instrument is often too small and the gold purification process takes too long.



(a) (b)

Figure 1: Retort principle (a), retort in practice (b). Source: Duijves and Heemskerk, 2014)

Aims

The primary aim of this project is to improve mitigation of mercury exposure at the source. A secondary aim is to reduce environmental pollution and exposure of local population to methylmercury. The following results are anticipated:

1. Find out what can be learned from previous attempts to introduce technology in gold mining
2. Develop an improved design for the retort and build a prototype
3. Test the prototype involving gold miners and improve the design
4. Find a local producer for the newly designed retort

Team

Name	Expertise	Affinity with Suriname	Role in the project
Romy Boerleider	Chemistry and toxicology	Born in Suriname, educated and now living in The Netherlands	Conduct the project
Rob Anzion	Laboratory technician	Not applicable	Laboratory testing
Gwendolyn Beckmann	Laboratory technician	Not applicable	Laboratory testing
John Courtar	Occupational medicine	Head of the medical office of the Labor Inspectorate at Min ATM	Advisor
Paul Leenders	Environmental technology	Work visit in 2010 as part of a previous NVvA fellowship[a]	Advisor
Marieke Heemskerk	Cultural anthropology	Consultant in Paramaribo http://www.heemskerk.sr.org/	Advisor
Harm Peters	Fine mechanical engineering	Not applicable	Building the prototype
Jan Quik	Chemistry	Head of the BOG chemical laboratory	Advisor
Paul Scheepers	Occupational hygiene and toxicology	Work visit in 2010 as part of a previous NVvA fellowship[a]	Project supervisor

[a] http://www.arbeidshygiene.nl/symposia/symposium-2011/

How it is done

The purpose of this application is to introduce improved technology to reduce exposure to mercury in five phases:

1. Interview
   Desk study and interviews about lessons learned regarding mercury reducing technology.

2. Develop a prototype and laboratory evaluation
   The team will present a draft step-1 design in the NVvA Newsletter and invite NVvA members to submit ideas for improvement of this design to a step-2 design. The efficiency of the step-2 design will be tested in the lab by preparing amalgam of known composition and determining the recovered mercury by gravimetry. A traditional retort will also be tested for comparison.

3. Test the step-2 prototype
   The team will present the retort prototype to a group of gold miners for field testing over a period over several months. After testing the researchers will interview the gold miners to evaluate their experience with the prototype. The field-test will be supported by measurement of mercury vapors in the breathing zone. A short video will be taken of a gold miner using the retort and after receiving his or her consent this video will be published on YouTube.

4. Improve the design
   The step-2 prototype will be improved to the final step-3 prototype and tested (only if needed)

5. Find a producer
   Metal workshops will be approached to see if they would be interested to turn the prototype into a product and produce the newly developed prototype retort and sell it to gold diggers at reasonable cost. If successful, the retort will also be made available for sale in an online shop.

Result

The development and evaluation of the improved retort design will be submitted to the Elsevier journal Environmental Technology and Innovation. The NVvA will be acknowledged for financial support. A summary of this paper will be submitted for publication in the Journal of Applied Occupational Sciences (TtA) and a contribution to the 2016 NVvA Symposium.

References

Duijves C and Heemskerk M (2014) Gold miner's knowledge, attitudes and practices with regard to mercury. A study in four small-scale gold mining regions in Suriname, Paramaribo Suriname, 71 pp.

Ouboter PE, Landburg GA, Quik JH, Mol JH, van der Lugt F. (2012) Mercury levels in pristine and gold mining impacted aquatic ecosystems of Suriname, South America. Ambio. 41(8):873-882.

Budget

Expenses		
Building the improved prototype retort		€ 3.000,--
Materials for production and laboratory testing		€ 2.000,--
Laboratory testing of efficiency		€ 2.000,--
Field testing of mercury vapor concentrations		€ 300,--
Flights Amsterdam/Paramaribo v/v		€ 4.200,--
Accommodation for 4 persons (2 days)		€ 1.000,--
	Total	**€ 12,500,--**

Funding		
Contribution from NVvA		€ 10.000,--
Contribution from Radboudumc		€ 2.000,--
Crowd funding		€ 500,--
	Total	**€ 12,500,--**