

MERCURY POLLUTION ABATEMENT PROJECT



PRESENTATION AT ASGM GLOBAL FORUM MANILA, PHILIPPINES

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OUTLINE OF PRESENTATION

- Objective
- Direct smelting – the technique
- Why is the technique used?
- Challenges
- Conclusions

OBJECTIVE

Introduce the direct smelting technique we hope will replace the use of mercury by artisanal and small-scale gold miners (ASSM) in Ghana

SLUICING



PANNING



GOLD CONCENTRATE IN A PAN



AMALGAMATION



SQUEEZING EXCESS MERCURY FROM AMALGAM



FIREPLACE FOR BURNING AMALGAM



SPONGE GOLD



GATHER AND SELL



MERCURY LOSS

- **Spillage during amalgamation**
- **Poor amalgam distillation**
- **Disposal of amalgamation tailings**
- **Further processing of sponge gold**

CRITERIA OF SUITABLE ALTERNATIVE FOR SSM

- **Effective**
- **Easy - no special equipment**
- **Quick**
- **Cheap**
- **Suitable for processing small batches of concentrate**
- **Visible - the miners should be able to see their products throughout the whole process**
- **Locally available**

DIRECT SMELTING

Method	Equipment/ Process	Principle	Applicability
Chemical	Direct Smelting	Melting black sand cones to produce pure gold	Smelting is applied in most small scale centres and miners are familiar with the method as it is being used for purifying sponge gold. It has been developed, tested and commercialised in Ghana. It can be use for all types of ores and comparatively cheaper than amalgamation.

SMELTING

- **Smelting is a high-temperature melting process used to recover metals from ores and concentrates**
- **Fluxes are added to the concentrate to assist melting and react with impurities so that the metal separates out**
- **The final products are pure metal and a glassy slag containing the unwanted components**
- **It can be used for all types of ores**

CHOICE OF DIRECT SMELTING

- **Fulfils all main criteria**
- **Uses non-toxic, cheap chemicals, borax, sodium carbonate, silica sand**

MIXING CHARGE AND FEEDING CRUCIBLE



LPG FUEL

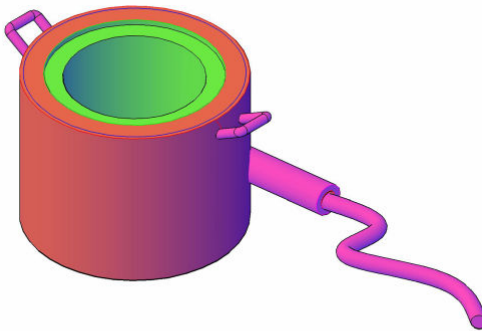


FURNACES



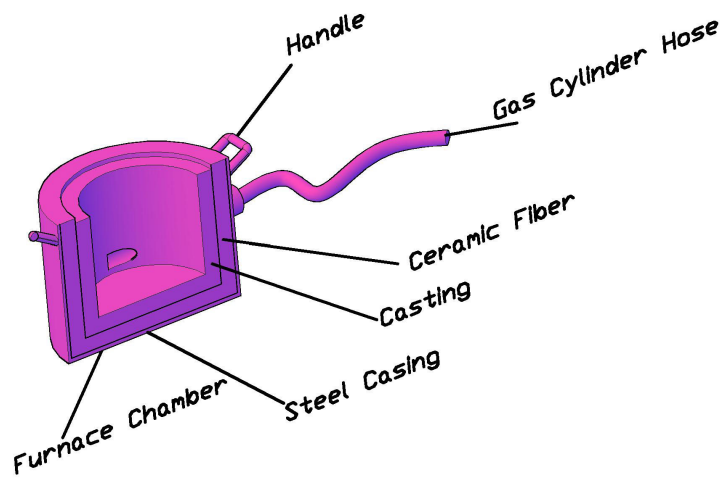
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GAS FURNACE



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GAS FURNACE



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DEMONSTRATION AND TRAINING



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DEMONSTRATION IN THE FIELD



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POURING OF MOLTEN MATERIAL



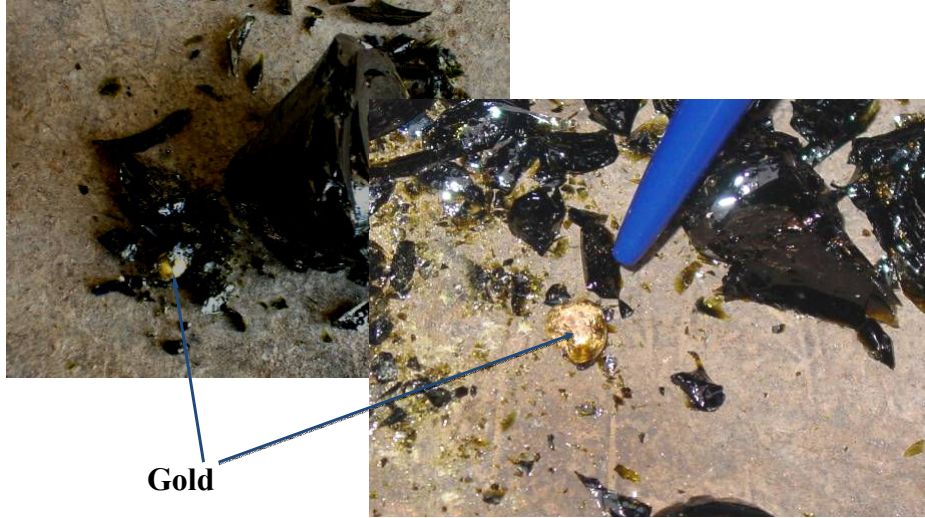
COOLING OF MELT IN A MOULD



SEPARATION OF GOLD FROM SLAG



SEPARATION OF GOLD FROM SLAG



GOLD BEAD



COST COMPARISON

AMALGAMATION			DIRECT SMELTING		
SN	Item	Cost (GH¢)	SN	Item	Cost (GH¢)
1	Half teaspoon of mercury (27 g)	4.00	1	4 Crucibles (2 operations)	1.60
2	Heating of amalgam (charcoal)	0.50	2	Flux (2 x 200 g)	1.20
3	Smelting	1.50	3	Gas (2 x 0.75 g)	1.20
	Total	6.00 (US\$4.14)		Total	4.00 (US\$2.76)

COST ESTIMATES for GAS KIT

SN	Item	Quantity	Unit Cost (GH¢)	Total Cost (GH¢)
1	Gas furnace (S/S)	1	500.00	500.00
2	Gas cylinder (15 kg)	1	70.00	70.00
3	Gas (15 kg)	1	15.00	15.00
4	Fire extinguisher (4 kg)	1	55.00	55.00
5	Tongs	2	7.00	14.00
6	Cupels	2	80.00	160.00
7	Hammer	1	3.00	3.00
8	Gloves	2	2.00	4.00
9	Goggles	1	4.00	4.00
10	Spoons	2	0.20	0.40
11	Weighing scale	1	100.00	100.00
12	Crucibles	100	0.40	40.00
13	Flux reagents	1	200.00	200.00
14	Mixing bowl	2	2.00	4.00
	Total			1169.40* (US\$806.5)

CHALLENGES

- 1. Retrieval of loan balances**
- 2. How is the money accruing from the sale of the kits to be used?**
- 3. Formation and sustenance of Small Scale Miners' Associations**
- 4. Sustenance of the Mercury Abatement Programme (accessibility & affordability)**
- 5. Further follow-up to sustain the momentum of the use of the technology.**

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THE WAY FORWARD - GHANA

- 1. Ensure that the kits are readily available and accessible virtually at the door steps of the SSM;**
- 2. Monies accruing from the sale of the kits should serve as revolving fund;**
- 3. Outstanding loan balances should be retrieved by the respective District Offices of the MC;**

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THE WAY FORWARD - GHANA CONT'D

4. Encourage the formation and strengthening of the SSM Associations
5. Monitoring and follow-up should be continued for at least two (2) years;
6. Use of the direct smelting method should be made a condition for the acquisition of license where amalgamation is used

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THE WAY FORWARD - GLOBAL

To achieve this feat it is recommended that the:

1. Countries should provide a budget or secure donor funds to launch the project possibly using the Ghana Project as model (at least €200,000.00);
2. Countries should organise Management Units (Ministry of Mines, University, NGOs, etc) to manage the projects;
3. Countries should recruit local consultants with experience in artisanal and small scale mining of gold to undertake the projects;

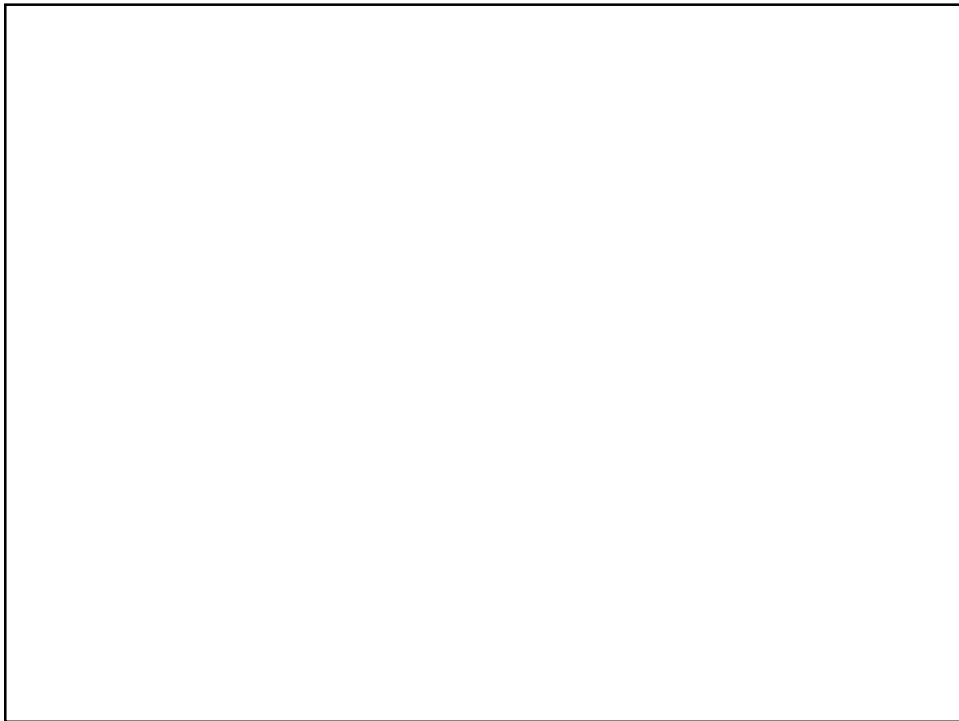
WAY FORWARD – GLOBAL CONT'D

4. Menart Geoventures Ltd, UMaT, Tarkwa – Ghana, be contracted to provide fabrication plans and a complete kit; and,
5. Menart Geoventures Ltd, may be contacted to provide high level consultants to supervise the projects.

ACKNOWLEDGEMENT

- **MINISTRY OF FINANCE & ECONOMIC PLANNING**
- **EUROPEAN UNION**
- **MINERALS COMMISSION**
- **PROJECT MANAGEMENT UNIT**
- **BRITISH GEOLOGICAL SURVEY**
- **UNIVERSITY OF MINES & TECHNOLOGY, TARKWA (UMaT)**

THANK YOU



**Gold Production in Ghana
(1995 - 2008)**

Year	Small Scale Mines (oz)	Large Scale Mines (oz)	Total Production (oz)	% small scale mines to Total
1995	127,025	1,581,506	1,708,531	7.4
1996	112,349	1,474,746	1,586,095	7.1
1997	107,097	1,677,911	1,785,005	5.9
1998	128,334	2,244,819	2,373,153	5.4
1999	130,833	2,358,423	2,489,256	5.2
2000	145,662	2,168,802	2,314,464	6.2
2001	185,596	2,184,313	2,369,909	7.8
2002	160,879	2,075,954	2,236,833	7.2
2003	221,063	2,085,070	2,306,133	9.6
2004	246,570	1,783,400	2,029,970	13.8
2005	225,411	1,913,534	2,138,944	10.5
2006	247,063	2,090,721	2,337,784	10.6
2007	338,594	2,239,696	2,628,290	12.9
2008	425,074	2,371,881	2,796,955	15.2

Provisional Gold Revenue (US\$) from Large and Small Scale Mining in Ghana (2002 - 2008)

Year	Small Scale Mines	Large Scale Mines	Total Revenue	% small scale mines to Total
2002	48,939,695	646,030,832	694,970,527	7.0
2003	79,822,133	740,219,541	820,041,674	9.7
2004	101,388,878	733,721,928	835,110,806	12.1
2005	96,327,095	804,897,250	901,224,345	10.7
2006	124,832,067	1,241,861,310	1,366,684,377	9.1
2007	38,848,229	688,872,105	727,720,334	5.3
2008	340,158,865	1,975,500,289	2,315,659,154	14.7

SMELTING VS AMALGAMAT'N

- **Smelting gave 99.9% recovery**
- **In the lab amalgamation gave around 97% recovery**
- **In the field amalgamation gave around 88% recovery**

ALTERNATIVE PROCESSES TO AMALGAMATION

- **Physical methods**
Shaking tables , special sluices,
Centrifugal concentrators, amalgamation
- **Chemical methods**
Coal gold agglomeration
IGoli
Haber process
Cyanide leaching
Direct Smelting

DIMENSIONS OF GAS FURNACES

ITEM	DIMENSIONS	
	Small Size (1)	Large Size (4)
Height	280 mm	280 mm
External Diameter	240 mm	405 mm
Internal diameter	170 mm	275 mm
Thickness of insulation	30 mm	60 mm
Thickness of metal shell	50 m	50 mm
Length of LPG inlet pipe	190 mm	190 mm
Air slot length	95 mm	95 mm
Air slot width	10 mm	10 mm
Number of air slots	3	3

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COST OF KIT WITH LARGE SIZE GAS FURNACE

SN	Item	Quantity	Unit Cost (GH¢)	Total Cost (GH¢)
1	Gas furnace (L/S)	1	480.00	480.00
2	Gas cylinder (15 kg)	1	70.00	70.00
3	Gas (15 kg)	1	12.00	12.00
4	Fire extinguisher (4 kg)	1	50.00	50.00
5	Tongs	2	7.00	14.00
6	Cupels	2	15.00	30.00
7	Hammer	1	3.00	3.00
8	Gloves	2	2.00	4.00
9	Goggles	1	4.00	4.00
10	Spoons	2	0.20	0.40
11	Weighing scale	1	80.00	80.00
12	Crucibles	100	0.40	40.00
13	Flux reagents	1	200.00	200.00
14	Mixing bowl	2	2.00	4.00
	Total			991.40

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COST OF KIT WITH SMALL SIZE GAS FURNACE

SN	Item	Quantity	Unit Cost (GH¢)	Total Cost (GH¢)
1	Gas furnace (S/S)	1	380.00	380.00
2	Gas cylinder (15 kg)	1	70.00	70.00
3	Gas (15 kg)	1	12.00	12.00
4	Fire extinguisher (4 kg)	1	50.00	50.00
5	Tongs	2	7.00	14.00
6	Cupels	2	15.00	30.00
7	Hammer	1	3.00	3.00
8	Gloves	2	2.00	4.00
9	Goggles	1	4.00	4.00
10	Spoons	2	0.20	0.40
11	Weighing scale	1	80.00	80.00
12	Crucibles	100	0.40	40.00
13	Flux reagents	1	200.00	200.00
14	Mixing bowl	2	2.00	4.00
	Total			891.40

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COST ESTIMATES for GAS KIT

SN	Item	Quantity	Unit Cost (GH¢)	Total Cost (GH¢)
1	Gas furnace (S/S)	1	500.00	500.00
2	Gas cylinder (15 kg)	1	70.00	70.00
3	Gas (15 kg)	1	15.00	12.00
4	Fire extinguisher (4 kg)	1	55.00	55.00
5	Tongs	2	7.00	14.00
6	Cupels	2	80.00	160.00
7	Hammer	1	3.00	3.00
8	Gloves	2	2.00	4.00
9	Goggles	1	4.00	4.00
10	Spoons	2	0.20	0.40
11	Weighing scale	1	100.00	100.00
12	Crucibles	100	0.40	40.00
13	Flux reagents	1	200.00	200.00
14	Mixing bowl	2	2.00	4.00
	Total			1166.40* (US\$804.41)