

ZIMBABWE

CLEANER PRODUCTION INVESTMENT PROJECT

Strategies and Mechanisms for Promoting Cleaner Production Investments in Developing Countries

Implementation of Cleaner Production at Midlands Metals



UNITED NATIONS ENVIRONMENT PROGRAMME

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PROJECT COVER SHEET

Country:	Zimbabwe
Project Title:	Sand mixing and reclamation
Sector covered:	Foundry
Project Impact:	Savings Z\$ 400 00.00
Project duration	2 years
Total Project Cost	Z\$ 770 000.00
Proposed Bank funding	Capital EUR
Other financing (name resources)	Capital EUR
Cost effectiveness (IRR)	46%
Coordinating enterprise	(TBA)

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1. GENERAL INFORMATION ABOUT THE COMPANY

Midlands Metals is a small and newly established foundry producing castings in grey iron to produce mill balls, small crushing hammers from materials sourced from local suppliers, (GMW Chemical Supplies, Metallurgical Supplies, Water Glass). The company was founded in 1998 and family owned and its operations are still very straightforward.

Location: Midlands Metals is at 1922 Bristol Road, Heavy Industrial Sites, Gweru and close to a big foundry, ZimCast and a transport company in the Heavy Industrial Area of Gweru.

Postal Address: P.O. Box 757, Gweru.
Phone: + 263 (0)54 21267/28703
Fax: + 263 (0)54 28074

Ownership: Family owned
Number of employees: 16 working two shifts of 8¹/₂ hours each /5 days a week.
Annual turn over: 2.8 million dollars based on the 1999 projections.

Production capacity: The Company is producing approximately 25 tonnes/month of castings. Its annual production is projected to be about 300 tonnes of castings. The foundry is planning to expand by building a new larger cupola furnace (approximately 2 tons/hour).

Markets: Mining, industry and farming.

Foundry process: Floor moulding and casting, which is done on a daily basis. Melt in the cupola furnace with 1.5 tonnes/8 hr production capacity. For the mill balls, the foundry use bentonite bonded green sand with coal dust. The crushing hammers are made in natural sand. After shakeout the sand is just screened manually. The foundry does not use cores.

2. CLEANER PRODUCTION ASSESSMENT

The main problem at the plant is inefficiency of the existing manual system of operation, which is contributing to the environmental problems of the company. The amount and cost of the basic raw materials the company use are as shown below:

SAND MIXING AND RECLAMATION

Item	Quantity per 50 kg mix (kg)	Annual quantity (kg) (56 mixes x 240 days)	Unit cost (ZW\$)	Total cost (ZW\$)
New sand (SF2)	10	134 400	0.86	115 584.00
Old sand (SF 3)	40	537 600	-	-
Bentonite	4	53 760	7.25	389 760.00
Coal dust	4	53 760	2.95	158 592.00
Water	3 litres	40 320 litres	0.90	36 288.00

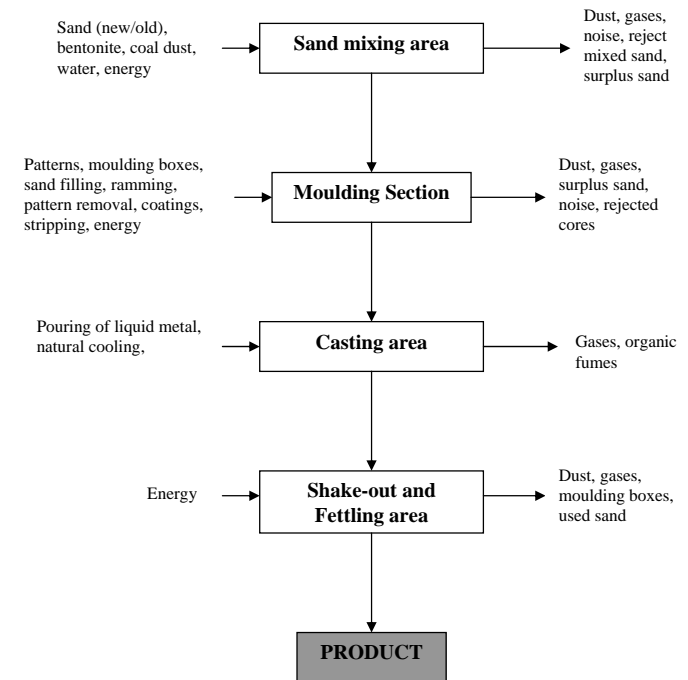
Total				700 224.00
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The present system uses about 2 800 kg of sand per each production of about 1 tonne of mill balls and small crushing hammers per day. The production is low and there is large waste of raw materials in the sand mixing. There are spillages during the sand mixing and some sand is lost in the form of dust. Often the sand mixture is of poor quality resulting in poor quality castings and loss of production.

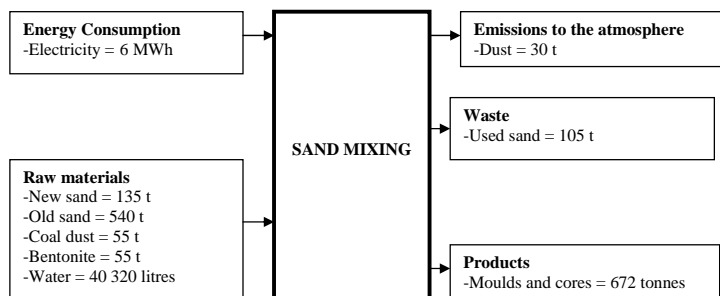
The sand mixing is purely manual and labour based (intensive), which takes about 4 hours to complete but the mixture is not completely homogeneous thus creating inherent problems like bur point blowholes. Sand reclamation stands at about 75% with burnt up sand being remixed with bentonite to try and cut costs, but the cost of chemicals still remain high.

Of environmental concern is the chemically contaminated sand finding its way to the water systems.

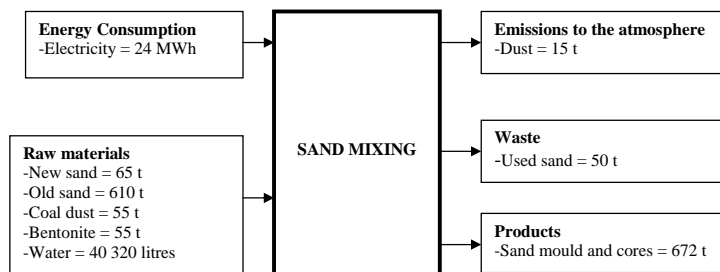
General Process Flow Chart of the foundry operations



Material balance for the sand mixing plant before the Cleaner Production project implementation



Material balance for the sand mixing plant after the Cleaner Production project implementation



CLEANER PRODUCTION SOLUTIONS

List of Cleaner Production options with no hardware investments

Option description	How many?	Yearly savings ZW\$	Benefit. Emission and waste reduction.	Implemented Yes/No?
Procedural measures	3	6 000.00	• 5% energy saving.	• Yes.
• Need to optimise furnace-melting conditions such as airflow rate, rate of melting and maintain proper burning conditions in the melting zone.		1 200.00	• 1% energy saving.	• In progress.
• A proper closing mechanism of the tapping hole of the furnace needs to be improvised.		1 200.00	• 1% energy saving.	• Yes.
• The melting pots should have good spouts				
Loss prevention	1	12 000.00	• 1-5% reduction in dust emission.	• In progress.
• Cover the new sand.				
Management practice	3	5 000.00	• 5% reduction in gas emission.	• In progress.
• Implement a more thorough inspection and segregation of the incoming scrap.		10 000.00	• 5% reduction in dust emission.	• In progress.
• Use sand with low dust content.		8 000.00	• 1% chemical saving.	• In progress.
• Workers need to be trained in proper handling procedures of the binder and hardener and in their accurate measurements.				

Cleaner Production option with hardware investments

Option description	Investment ZW\$	Yearly savings ZW\$ per year	Pay back years	Emission and waste reduction
Installation of sand mixing and reclamation plant.	770 000.00	400 000.00	1.9	24% raw material saving.

3.SELECTED PROPOSAL

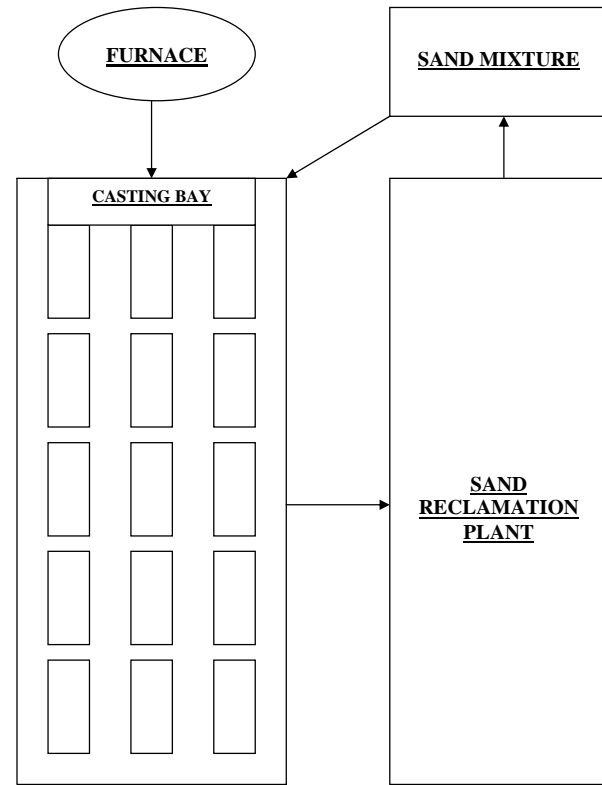
Sand mixing and reclamation plant

The proposed option would enable the company to save on bentonite, by using a roller sand mixer for the green sand. A 500-1000 kg mixer would cope with the anticipated product demand. A second hand roller sand mixer can be obtained from Europe. The equipment comes with all its accessories and can easily be installed.

For the green sand reclamation, the company needs a shaker and a conveyor system to take the sand up to a storage hopper above the roller sand mixer. The shaker should have a screen to remove any undesirable lumps in the sand. This system can easily be constructed using internal labour.

An improved sand mixer and reclamation system will have the following advantages:

1. Quality of mixture improves with an improvement in quality of product and hence no more bubbles and rejects.
2. Raw material saving improves with minimum loss due to dust and manual handling.
3. Minimise environmental degradation, as most of the chemicals will be retained in a clean environment.
4. Labour costs are reduced by about 30% from the present system.
5. Maintenance costs of plant and equipment are also reduced greatly.
6. Down time will improve with better production levels.
7. Production will improve from the present 1 tonne per day to between 5–7 tonnes per day and hence improving the profitability margin and will result in an improvement of the workers conditions.



ENVIRONMENTAL EFFECT

There would be a 24% reduction in the loss of raw materials. The implementation of the project would result in reduction in dust emissions and an improvement in the working environment.

ECONOMIC EFFECT

Cost of the Investment

Roller sand mixer + accessories + shipment	\$ 350 000.00
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Sand shaker	\$ 160 000.00
Sand screen below the shaker	\$ 15 000.00
2 x 5 kW motor	\$ 40 000.00
10 m conveyor belt	\$ 30 000.00
Other construction material	\$ 20 000.00
Sand storage hopper	\$ 50 000.00
Installation costs	\$ 35 000.00
Contingencies	\$ 70 000.00
Total	\$ 770 000.00

Costing of the present system

The costs of running the present system are quite high with a generally low output. It costs \$8 300.00 per day to produce 1 tonne of mill balls, with bentonite and coal dust being used heavily.

Labour cost (16 people @ \$15.00 per hour for 8.5 hours a day)	\$ 2 040.00
Cost of overheads and raw materials per day	\$ 6 260.00
Total cost of production per day	\$ 8 300.00

Annual labour costs	\$ 489 600.00
Annual cost of overheads and raw materials	\$1 502 400.00

Total cost of production per year (x 240 days)	\$1 992 000.00
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At the moment, 75% saving on chemicals and sand is being realised. The savings are expected to improve to 99% with the new system.

Based on the assumption of the above figures, 25% of raw materials are being lost per each cast. This translates into \$1 565.00 per day and **\$375 600.00** per year.

Profitability on the current system

Daily profit	\$ 3 320.00
\$3 320.00 per x 20 working days x 12 months	\$796 800.00
Less cost of material loss	\$375 600.00
Net profit	\$421 200.00

Running costs of the proposed system

With the proposed system, a 1% loss of raw materials will occur.

The new plant will employ 11 people, which is a 31.25% reduction in cost of labour. Therefore the company is going to save **\$153 000.00** annually on labour.

Production will increase from 1 tonne per day to 6 tonnes per day. This means the profit will increase 6 times daily: \$3 320 x 6 = \$19 920.00. This translates to **\$4 780 800.00** as annual profit.

Profitability of the proposed system

Profit	\$4 780 800.00
Add saving on labour	\$ 153 000.00
Total profit	\$4 933 800.00
Less 1% of material loss	\$ 493 380.00

Net profit	\$4 440 420.00
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Savings that would be realised by the proposed system

31.25% saving on labour	\$153 000.00
24% saving on raw materials	\$360 576.00
Less running costs	\$113 576.00

Total net savings	\$400 000.00
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4. INVESTMENT ANALYSIS

ANALYTICAL TECHNIQUE	VALUE	CONSIDERATION
Payback	2 years	Acceptable
Net Present Value	Z\$ 1 118 417	Acceptable
Internal Rate of Return	46%	Acceptable

5. COMPANY'S ECONOMIC HEALTH ANALYSIS

RATIO	1999	1998		CONSIDERATION
ROCE	23%	27.1%	negative	unfavourable
TOTAL ASSETS T/O	1.3%	1.5%	negative	unfavourable
CURRENT RATIO	1.6	1.3	positive	favourable
ACID RATIO	1.2	0.6	positive	favourable
GEARING	0	0	zero	
EQUITY RATIO	1	1	zero	
GP MARGIN	53.5%	55.7%	negative	unfavourable
NP MARGIN	1.7%	9.9%	negative	unfavourable
DEBTORS AVE.	115	71	positive	unfavourable
CREDITORS AVE.	24	111	negative	unfavourable