Industrial Energy Efficiency Project in South Africa

Case Study

Company name	**Zimco Aluminium Company (ZIMALCO)** **A division of the Zimco Group (Pty) Ltd** **3 Falkirk Road, Industrial Sites, Benoni 1501, Gauteng, RSA.**		
Sector	**Metallurgical**		
Company Contact	**Name: Neels van Niekerk**		**Position: Engineering Manager**
	Email: Neelsv@Zimalco.co.za		**Telephone: =27 (0) 11 914 4300**
Year joined NCPC Project	**2015**		
Year of interventions	**2015**	Duration (months)	**Six (July to December 2015)**
Utility Intervention	**EnMS and Gas Furnace**		
Case Study Author	**Wendy da Cruz**		
Project Manager	**Faith Mkhacwa (FMkhacwa@csir.co.za)**		

1. BACKGROUND

1.1 Company profile

Zimalco is the largest manufacturer of secondary aluminium products in Sub-Saharan Africa. Specialising in the production of aluminium foundry alloys, powders and deoxidants, Zimalco is also South Africa's only manufacturer of primary aluminium based master alloys, hardeners and grain refiners.

Zimalco is a division of the Zimco Group (Pty) Ltd, South Africa's leading producer of industrial and base minerals and a major supplier of zinc and lead-related chemicals and engineering plastics. The Group incorporates some of South Africa's leading recycling companies including Fry's Metals (lead, automotive batteries and plastic); Zinchem (zinc and zinc dross) and Zimalco (aluminium and aluminium dross).

In 1989 Zimalco became the first secondary aluminium smelter in South Africa to be listed under the SABS 0197 Quality Manufacturing Standard. Today Zimalco is listed under the current ISO 9001 Quality Management System, OHSAS 18001 Occupational Health and Safety and ISO 14001 Environmental Management Systems. These ensure that the Zimalco products and services not only fully meet their intended quality and service but also that they are manufactured with consideration for the safety of all employees and users of Zimalco products, while the immediate environment and that influenced by Zimalco operations is well managed to reduce the effects of the Carbon footprint.

The company was founded in 1948 and is the beneficiary of many decades of experience and stands out amongst its peers as the leader in technical innovation. It also has access to the most advanced international technology through information exchange with research groups and other international leading suppliers of secondary aluminium. Such expertise and competence provide a sound backing for all its products and it has the ability to challenge international suppliers of similar products, especially in terms of quality, cost and service.

The bulk of the Zimalco business comprises of the supply of international standard products to markets both locally and around the globe. Zimalco also produces many specially designed products to meet customers' specific process needs.

For customers' assurance of these principles the Zimalco products are marketed under the world renowned and registered brand names SUPRAL for foundry ingots and SUPRAMEX specialty powders, both of which enjoy an enviable reputation for quality.

1.2 Plant profile

The Zimalco plant, with a capacity in excess of 30,000 ton per year and employing more than 160 people. Raw materials are obtained from many of the South African aluminium converters, scrap metal recyclers and when required from the primary aluminium smelters.

Production processes are divided into 4 distinctive streams where the various grades of aluminium scrap are sorted, smelted, alloyed, atomised, processed and blended to meet international and customer specifications:

- Scrap is sorted, smelted and alloyed to produce specification alloys for the foundry and die casting industries and for use as deoxidants in the manufacture of steel.
- Primary aluminium is melted and alloyed to produce primary and master alloys for use in foundries, rolling mills and for the production of water treatment chemicals.
- Primary and commercial scrap is melted and atomised to produce aluminium powders of various fraction sizes which are blended to meet customer specifications for the production of explosives and various chemical and exothermic applications.
- Aluminium drosses are processed to recover the metal content and to convert them into a product that can be used as a raw material input for downstream industries thus preventing the disposal into hazardous waste sites and keeping the company "GREEN".

Zimalco products include:
Foundry Alloys, Powders, Master Alloys and Pellets and deoxidants.

1.3 Energy Profile

Energy source breakdown based on 2014 total annual consumption equivalent of 31 636 464 kWh

Gas	= 80 %
Electricity	= 17 %
Diesel	= 3%

1.4 Nature of challenges

The EnMS implementation approach has been recognised as a way to systematically improve energy efficiency and therefore a directive from ECOBAT, the holding company was issued to all Zimco Group companies that all sites should implement EnMS as per international standard.

In response to this, the Group SHEQ Manager, contacted the NCPC to enrol in the IEE EnMS programme.

1.5 IEE capacity building programme

As part of the initial Zimco Group capacity building, both the Zimalco Engineering Manager and Electrical Foreman attended the In-House 2 Day End user training presented by the NCPC at Zimco in March 2015. The value of the systematic approach was immediately realized and further training arranged. The Engineering Manager together with the Electrical Foreman and Technical Manager (who is also responsible for the Quality, Environment and H&S management System) continued on to the EnMS Expert programme which commenced in May 2015, using Zimalco plant as one of the four candidate plants.

The attendance of the training and participation in these programmes significantly influenced the Zimalco IEE initiatives, enabling a complete EnMS to be integrated with the existing SHEQ Integrated Management System (IMS) within five months.

2. KEY ACHIEVEMENTS

Key findings table -

Implementation Period (yyyy-yyyy)	2015
Total Number of projects	3 projects on Furnace No. 12
Monetary savings in ZAR	R 501 000 for six months July to December 2015
Energy savings in KWh	5326 GJ (for six months - July to Dec 2015) [1 479 444 kWh equivalent]
Total investment made ZAR	R 335 000
Payback time period in years	< 1 year
GHG Emission Reduction (ton CO2)[1]	299 tons* for six months * CO2 Conversion Factor for Natural gas: 0.0561 tons CO2e per GJ Reference: The GEF / IPCC Index applied for IEEP Phase II

3. IMPLEMENTATION OF AN ENERGY MANAGEMENT SYSTEM

Phase One: Capacity building through training (IEE 2-day End User and EnMS Expert level training and in-house awareness, internal and assisted by the NCPC IEE Project Manager.

Phase Two: Energy review to determine energy profile including baseline and baseload for significant energy sources, being gas and electricity and to identify energy performance improvement opportunities.

Phase Three: Implement and quantify energy savings and communicate to management to promote buy-in to the concept of systematic energy performance management

Phase Four: Integrate the EnMS into the existing SHEQ / IMS.

Phase Five: Internal EnMS audit and Management Review.

4. IMPLEMENTATION CHALLENGES

Credibility of Energy Management

There was initial caution from Top Management to accept the potential energy savings opportunities. Once the energy performance was quantified to validate the savings, this was overcome. Improvement targets were achieved and exceeded and new ones set to support continual improvement.

Energy Team

A critical success factor identified and managed was that composition of the Energy Team include members who have the necessary technical knowledge and understanding of the plant and it's SEU's.

Data Management

Top Management was committed to energy savings and set savings targets to reduce GJ/Tonne but did not have a formalized way to measure. Although sub-metering has been in place for some time, prior to the EnMS approach there was no systematic way to analyse the data to compare actual to expected consumption. This was addressed through the use of the baseline regression and associated EnPIs. The use of the IEE EnMS Tool provided as part of the NCPC training was of great assistance.

5. HIGHLIGHTS OF OPERATIONAL/ESO INTERVENTIONS

5.1 Summary of all interventions

Resource	Carrier	Intervention	Utility saving (Units) Period	Investment (ZAR)	Savings (ZAR/yr)	Payback (Yrs)	Period	GHG Emission Reduction (Kg CO2/ year)
Reverbratory Furnace No. 12 Retrofit	Gas	Retrofit burners and modify capacity of No 12 Reverbartory furnace from 5 ton to 12 ton	5326GJ – from July to Dec 2015 calculated as savings against expected consumption using the 2014 baseline regression.	R 335 000	R501 442 Using average cost of R94.15/GJ for Sasol Gas	< 1 year	6 months: July 2015 to Dec 2015	299 tons* for six months 598 tons/year- * CO2 Conversion Factor for Natural gas used 0.0561 ton CO2e per GJ
Dross heat recovery	Gas	Pre-heating of sows ***Reference*** Dross Sow Heat Recovery Tab: Zimalco EnMS Data for Case Study 2016-02-11						
Behavioural changes and operational control improvement	Gas	Training and awareness understanding – for example keeping furnace doors closed, response poor operational control	***Reference*** No 12 Furnace Regress & EnPIsTab: Zimalco EnMS Data for Case Study 2016-02-11	***Reference*** CAPEX Tab: Zimalco EnMS Data for Case Study 2016-02-11	***Reference*** No 12 Furnace Regress & EnPIsTab: Zimalco EnMS Data for Case Study 2016-02-11			***Reference***: The GEF / IPCC Index applied for IEEP Phase II

5.2 Details of highlights

Furnace No. 12 Retrofit and Expansion

Historically this was the lowest performance furnace of the furnace family, with a capacity of only 5 ton and gas consumption of 2.4GJ/hour. With the intervention, it now has a 12 ton capacity using 1.3 GJ/hour. The size of the furnace was increased, the burner was relocated to the centre of the furnace as opposed to the sides, behavioural changes were made in terms of keeping the furnace door closed as much as possible.

Pre-heating of Sows using waste heat from the dross

Although initially concern was expressed about this intervention, based on sound engineering principles and calculations it was implemented and has resulted in significant savings. When the pre-heated sows are used, the furnace retention time is reduced by up to 35%. The latter is dependent on the charge makeup.

Behavioural changes and operational control improvement

Different types of training for different role players conducted with intention of enhancing understanding of energy performance and how individual actions influence energy saving versus wastage.
Operational control was improved through training to encourage supervisory staff to respond speedily to operational inefficiencies.

Carbon Tax Potential Benefits

With the annual predicted savings of approximately 600 ton CO_2e for the Furnace 12 energy intervention, this also has significant non-energy financial benefits.

6. BENEFITS & LESSONS LEARNED

Challenge	Remedial Action taken	Additional Planned Action
Role players Understanding/ contribution EnMS	Information/ awareness and training	Developing role players.
Interpretation of SANS 50001 standard and conformity	Consultancy	Training on implementation and auditing
Measurement validation	Data extrapolation	Install sub-metering as additional needs are identified
Reliable data	Automatic data capturing	Scale-up automatic data capturing
Input tonnage versus output tonnage as the driver / variable	Differentiate between energy performance and sales performance	Proof of energy saving versus sales volumes

6.1 Benefits

- Reduced cost per ton.
- Practicality of the EnMS Tool provided by the IEE programme as part of the training.
- Measurable outputs – one knows if energy performance is good or not because of the focus on energy data.
- As staff grasped the concepts of energy performance, they were more and more involved and motivated to contribute and maintain the savings.

6.2 Lessons

- Staff cannot help the energy performance improvement if they don't understand the concepts – training and understanding are key.
- Importance of getting buy in and understanding of the concepts of energy performance and saving by reporting factual data that supports success reporting.
- Need to ensure that the "energy language" that is used is understood consistently throughout the organisation.
- Critical to back up staff training which promotes behavioural changes with technology – for example the implementation of sound incident logging which highlights efficiency deviations to which supervisors can respond. This enables control of the outputs which are influenced by behaviour.
- The Energy team is competent from both the theoretical and practical point of view. One of the key success factors was the composition of the Energy Team which included both technical engineering staff with excellent knowledge of the plant and the SHEQ/IMS role players. Without technical know-how the ability to identify energy opportunities is limited.

6.3 Quotes

- You can't do if you don't understand – everyone needs to understand why and not only what needs to be done to optimize energy performance.
- Time means energy. If you don't manage time you can forget energy management.

Annexures/References

- Zimalco EnMS Data for Case Study 2016-02-11
- The GEF / IPCC Index applied for IEEP Phase II