Blacksmith Institute

Site visit to the Doe Run Peru La Oroya Metallurgical Complex

Control of Process and Fugitive Emissions in the Plant and the Community

May 2008

Brian Wilson
International Lead Management Center

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Doe Run Peru

La Oroya Metallurgical Complex – the Control of Process and Fugitive Emissions in the plant and the community

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1. **Introduction to Doe Run Peru.**

Operations at the metallurgical complex at La Oroya in Junin province began in 1922, smelting a polymetallic mix to produce 10 refined metals including silver, lead, copper and zinc. The environmental impacts of the smelter operations were not given the consideration consistent with current practices for the first seventy five years of operations.

In the 1990s, as environmental awareness increased the Peruvian Government gradually put in place a more comprehensive legal framework to protect the environment. During these years, Centromin Peru, the state owned company which, at that time operated the La Oroya Metallurgical Complex (LOMC), gradually began to put in place some environmental systems as it prepared the company for privatization.

Prior to privatization the LOMC was divested from Centromin Peru (its former state controlled owner) and subsequently after acquisition in 1997 it became known as Doe Run Peru SRL.

DRP has a legal commitment to implement a comprehensive environmental upgrade to the complex; that is the “Program of Adaptation and Environmental Handling” (PAMA). However, due to the complexity of the improvements required at La Oroya, and at the request of the Company, the Ministry of Energy and Mines (MEM) increased the original 10 year PAMA in Peru by 3 years for DRP, taking the program to the end of October 2009. The financial commitment resulting from this final extension to the PAMA increased the investment by DRP from ~ US$ 107.5 M to ~ US$ 244 M.

The PAMA originally proscribed nine environmental projects designed to ensure that any solid waste, effluent discharges or gaseous emissions from the operations at La Oroya were under the respective maximum permissible limits (MPL).

The implementation of the PAMA requirements by DRP followed a three phase strategy that prioritized the environmental needs in the following order:

i. Solids
ii. Liquids
iii. Gasses

By the end of 2006, DRP had completed 8 of the 9 PAMA projects. The outstanding project is the “Sulfuric Acid Plants”. When completed the Company’s sulfur dioxide emissions will then be entirely under process control. The next phase of this project, that is the Lead Circuit Acid Plant is now nearing completion and is due for commissioning by the end of September 2008. The final phase, that is, the Copper Circuit Acid Plant is due for completion in October 2009.

2. PAMA Projects

1. Copper circuit water treatment plant US $3.09 M
2. Industrial Waste Water Treatment plant US $ 39 M
3. Slag handling system and safe disposal US $9.71 M.
4. Huanchán waste dump remediation US $1.07 M
5. Arsenic trioxide deposit upgrade at Vado US $2.42 M
6. Upgrade of the ferrites deposit at Huanchán US $2.10 M
7. Domestic waste dump upgrade – Cochabamba US $2.64
8. Monitoreo / Aerofotografía station US $ 0.63 M.
9. Sulfuric Acid Plants …….. US $ 152* M

* includes US $ 52 for the installation of the Copper Circuit IsaSmelt

3. Significant PAMA Achievements

During the completion of the Water Treatment Plant (WTP) Project the use of water at the complex was optimized leading ultimately to a reduction in the number of effluent discharge points to the Mantaro River from 34 to 4 outlets, and of the four remaining only one is a process discharge. In addition, effluent discharge volumes to the Mantaro River have been reduced from an average of 42 m^3/min in 1997 to 5 m^3/min today.

As a result of the construction and commissioning of the WTP the LOMC effluent discharges into the Mantaro River and/or tributaries do not contribute any measurable level of pollution nor do they cause any detectable negative impact on the quality of its waters.

Lead in the waste water discharge is currently averaging 0.02 mg/l, against the limit of 0.1 mg/l and similarly for Arsenic at 0.06 mg/l against the limit of 0.2 mg/l and Cadmium at 0.02 mg/l against a limit of 0.05 mg/l.

DRP have also commissioned three sewage treatment plants to process waste from approximately 10,000 people living in company housing and the waste from the plant.

Reductions in the SO_2 emissions in compliance with the legal limits will be secured on the completion of the acid plant projects, which had to be rescheduled while consideration was given to the selection of the right option; that is, deciding whether to have one central plant or separate plants for the lead and copper circuits.

The decision to opt for two plants increased the costs, and led to the rescheduling of the PAMA completion date, but the Zinc circuit acid plant was re-commissioned in 2006 and construction of the Lead circuit acid plant is only months away from commissioning. DRP will then be able to further reduce the SO_2 emission levels and when the third acid plant for the copper circuit is commissioned in October 2009, DRP will be in full compliance with the SO_2 emission regulations.

The capture of the SO_2 as Sulfuric acid requires the construction of acid storage tanks and three such tanks are days away from completion and commissioning.

The new slag management system has reduced the amount of “fine solids” dumped in the Montaro River from approximately 40 tons per day to zero. All the slag produced on the site is now conveyed by a “ski lift” bucket system to the dump site about 1 kilometer from the smelter. Bucket filling is computer controlled to a specified safe level and there is little evidence of spillage either around the filling carousel or below the cables.

4. Improving Air Quality and Reducing Fugitive Emissions

Improvements in air quality are not just about building new baghouses and changing the filter systems. Reducing the volume of process emissions and eliminating certain atmospheric contaminants by changing or re-engineering the process have been fundamental to the strategy adopted by the management at la Oroya.

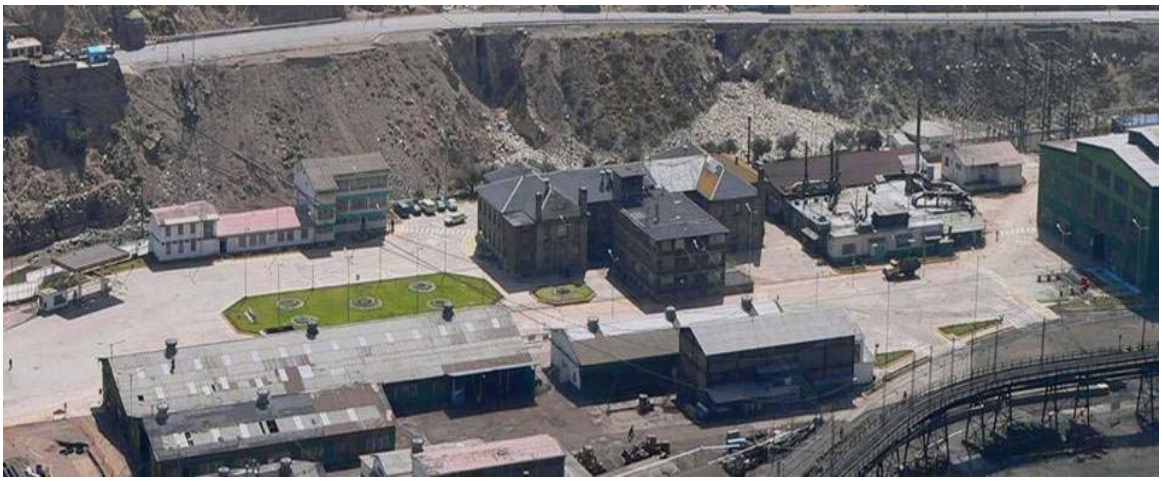
A key development in this strategy has been the introduction of oxygen to the furnaces, thereby increasing the burner efficiencies and reducing the burden to the main stack.

Upgrading the electrostatic precipitator has reduced the emissions of particulates from the chimney by 23%, and this together with the closure of the Zinc roasters adds up to a total of reduction of 35% thereby taking atmospheric discharges below the LMP of 100 mg/m^3 to an average of approximately 60 mg/m^3. Further reductions will be achieved when the final Acid Plant is commissioned.

Nitrous gas emissions have also been reduced with the introduction of a new ventilation system in the precious metal refinery.

A wide range of Projects, some not included in the PAMA have been completed as part of the DRP objective to improve air quality and reduce fugitive emissions, particularly in the lead and arsenic process streams.

Ten years ago there were many sources of fugitive dusts and emissions, but the main sources were virtually eliminated by installing the new baghouses, enclosing the process areas and paving the dirt roads to create a clean site that could be maintained to provide a dust free working environment.



To date a total of 63 k m^2 of dirt roads have been paved at a cost of US $ 2.4 M, which includes a huge undertaking to ensure that all the underground drainage, process feed and electrical cabling was in place before any area was paved.

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Once paved the roadways are subject to mechanical and manual cleaning 24 hours a day to ensure that the trucks and plant vehicles do not create any dust clouds. Total investment in the fleet of road sweepers is US $ ~ 800 k.

Another project to reduce fugitive emissions currently under review and consideration for capital expenditure is to enclose the lower levels of the lead sinter plants to eliminate leaded dust.

Plans are also in hand for the containment and capture of the fugitive emissions from the refinery floor that will reduce the lead in air and arsenic and cadmium concentrations.

A copper converter

At first, the installation of a Copper IsaSmelt could be considered to be a process improvement to strengthen the bottom line, but when commissioned in October 2009, the single IsaSmelt furnace will reduce the number of Copper Converters from four to one and eliminate four out of the six operating copper roasters, thereby significantly reducing the risk of fugitive emissions.

During the visit all that was visible was the concrete plinth for the steel body of the IsaSmelt furnace.

New enclosed baghouses have been installed to serve the lead furnaces and all baghouse systems are also under a review for future improvements.

Left and below - new baghouses

Fugitives from the fusion beds in both the copper and lead circuits have a new work regime designed to minimize the dust emissions by spraying a fine water mist onto the beds.

As a final precaution against the transmission of dust from the site a US $ 750 k truck and vehicle high-pressure wheel wash has been installed at the exit to the plant. Without exception all vehicles that have been in the process areas are subject to a vehicle wash. Dusts from the vehicles are collected in a sump and returned to the process.

A further potential source of fugitive emissions in the community and the surrounding area is from the open top railway wagons that transport the concentrates to the smelter from the mine sites. In theory and in accordance with best practice, open top railway wagons should not be filled to the top of the wagon. A safe fill level should be marked on the wagon and filled only to that level. Inspection of the few wagons on site during the visit showed that the vast majority of wagons were filled to a safe level, although the observation is arbitrary, as a safe level was not clearly marked. One wagon was seen to have been filled to the top, but it was not clear what was in the wagon. Nevertheless, and despite the fact that all the open wagons are covered with canvas for transit and regardless of the material all the wagons should be filled to a safe level that is fixed so that the risk of spillage is minimal. Filling to the top of the wagon, and despite the canvas cover, will inevitably lead to the deposition of concentrate along the length of the railroad and contamination of the surrounding areas.

It is recommended that a safe filling level is set for all concentrate wagons and that a final inspection regime is set up at the mine site to ensure compliance.

5. Community Dust Control Measures

The population of La Oroya is approximately 50,000 inhabitants and the area with the most pronounced legacy issues is the oldest part of the town, known as La Oroya Antigua with a population of approximately 35,000 inhabitants. It is located on the opposite bank of the Mantaro River to the metallurgical complex of DRP, a distance, for some homes of only a couple of hundred meters. This neighborhood is the most heavily contaminated part of the town of La Oroya, not only because in many instances the houses are the oldest in the town, due in most part to its proximity to the plant and the geography that virtually traps any emissions in the valley. This is particularly pertinent on those days when weather conditions are such that there is an inversion and emissions from the main stack "fall" onto the town instead of rising out of the valley.

Added to the problems caused by the geography and the proximity to the plant, the community of La Oroya Antigua is a poor neighborhood. Many of the houses were originally built to "squatter" standards, that is, no building regulations, cement blocks, mud plaster and dirt floors, and no sanitation or potable water. In 1997 many of the roads in the area were just dirt contaminated with 75 years of the complex's emissions, including high levels of lead and heavy metals.

La Oroya Antigua

Since then the majority of the roads and sidewalks in La Oroya Antigua have been paved and there is an on-going voluntary program funded by the Company to refurbish approximately 25 homes a year in the community at a cost of US $ 5 k for each house.

During a house refurbishment all the internal walls are replaced or re-surfaced with lead free plaster, the floors are paved and where possible sanitation and potable water are installed.

However, this program will take many years to completely refurbish all the homes in La Oroya Antigua in need of a “make – over”.

The area requires considerable cleaning to keep the streets free of dust. With the assistance of the Company and the full cooperation of the local municipal authority, there is a full time mechanized and manual street cleaning team and they are assisted by local volunteers from the women’s action committee.

In addition to the street cleaning, DRP also supports an internal domestic cleaning program using HEPA vacuum cleaning and wet dust removal.

6. Cuna Jardin – Casaracra Children's Nursery

The Peruvian Ministry of Health (MINSA) is responsible for all community based health projects and DRP is actively involved in the program providing financial and logistical support as part of the extended PAMA Program.

One of the most important community projects is the pre-school (6 years and under) nursery at Casaracra for 100 children with elevated lead in blood levels.

MINSA employs 10 nursery teachers, together with a number of experienced specialist psychologists, nutritionists, social care workers, and pediatricians.

Casaracra was refurbished in 2005 and provides the La Oroya community with an approach that helps children and parents share experiences that will stimulate and provide education for them in practical ways designed to reduce lead levels and improve health prospects.

The nursery has showers for the children, potable water and provides them with nutritional meals, including a daily milk allowance supplied by the Health Ministry, during their daily eight hour stay at the center.

The children travel to Lima three times a year and are examined by a specialist medical team at the San Bartolomé Hospital and the National Institute of Rehabilitation for Callao.

However, the surveillance of the children under the direction of Dr. J D Matos, has shown that the health problems are complicated. They have elevated lead in blood levels, but 25% of the children are also anemic which may or may not be lead related and could, like other systems, be associated with a poor diet, lack of potable water and other localized infections.

In addition to the 100 meals provided at Casaracra, DRP also fund the provision of a further 250 meals each day for children in La Oroya Antigua that do not or cannot attend the Day Nursery. These meals are provided in a number of kitchens installed by the company in the community in an effort to improve the diet of the children.

What was clear during the visit to La Oroya is that the project at Casaracra is not only a successful program, but vital to the community of La Oroya Antigua and the children it serves. Unfortunately, only 100 children can be accommodated at the nursery. Of course, the criteria for selection means that the children at the nursery are the ones in most need of intervention and special care, but Government and Industry sponsored surveys indicate that there may be as many as several hundred young children with elevated blood lead levels living in the La Oroya area that would benefit from a similar program to that offered at Casaracra. .

ILMC May 2008