Remediation of Mercury Contaminated Soils at the Miramas Site - 12243

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AREVA

ABSTRACT

Beneficial “new” use of the Miramas Site is the remediation objective for a former light isotope manufacturing facility. Remediation operations will remove contaminated soils and materials and deconstruct facilities. The remediation objective is faced with project challenges and regulatory requirements that dictate/influence the outcome. The operation consists of the remediation of approximately 100,000 cubic meters of soil and the decommissioning of facilities. The types and ranges of waste are the result of historical processing activities (chemical facilities, pyrotechnic components storage, mining component treatment and light isotope manufacturing activities). Mercury is the primary component of the waste, but metals and organic compounds are also possible waste components. A thermal desorption process is used to remove Mercury from the polluted soil while a biological treatment is considered to the organic nitrate compound removal. A focus is done on the technologies used to remediate the Mercury contaminated soil. After few months of operation, the first results confirm that the technology choices were relevant and the soil remediation project is a success.

INTRODUCTION

The AREVA’s MIRAMAS site (see Fig. 1.) is located in the Southeast of France. The site has an area of 37 ha (91.5 acres), but only half is concerned by the remediation and the deconstruction operations. The site is located close to the town of Miramas. Thus, maximum preventive measures are implemented to optimize the confinement of operations. The Miramas site was industrial for about 100 years. This industrial activity was primarily associated with national defense purposes.

Fig. 1. The Miramas plant

The initial activities between 1918 and 1954 were the preparation of nitrogen and sulphur products for a powder mill located near the site. The site was subjected to three major

events during the World War II: the first event was the explosion of a munitions train in the yard located at the edge of the site. The explosion results were the partial destruction of buildings and storage facilities on the site. The two other events are two bombings in 1944.

The site was then operated by a mineral processing company between 1954 and 1959 and the major product was nickel.

The AREVA's activity began in 1960 in the centre of the site. The activity was focused on the production of light isotopes and mainly of lithium-mercury amalgam isotope separation. Obsolete infrastructures were demolished in 1986; wastes from the demolition were placed in a land covered confinement hill. The treatment of this hill is one of the main project operations. The end of the Li production and the shutdown of the plant took place in 2009. The site is currently under cleanup and dismantling activities.

The objective of the project is to process contaminated soil and materials and to deconstruct all the facilities to prepare the site for the arrival of a new industrial activity.

Given the volume of material to be treated, the first challenge was the decision to install treatment processes on the site in order to reduce logistics flows. The second challenge was to optimize the management of demolition waste. But, the most important challenge was to master the safety of all those taking part on the operations.

METHODS

Environmental conditions

The environmental condition of the site is characterized by two main footprints. The first and most important is the mercury footprint. It is located mainly in the hill of material mentioned above but also in the basement foundations of buildings and annexes where mercury was used (see Fig. 2.). The second footprint is a nitro-naphthalene one. This footprint is the result of the production of nitro products. However, the direct link between the area concerned and this activity is unclear. There are also spots of contamination by heavy metals, PCBs and diesel, due to the mineral processing activity.

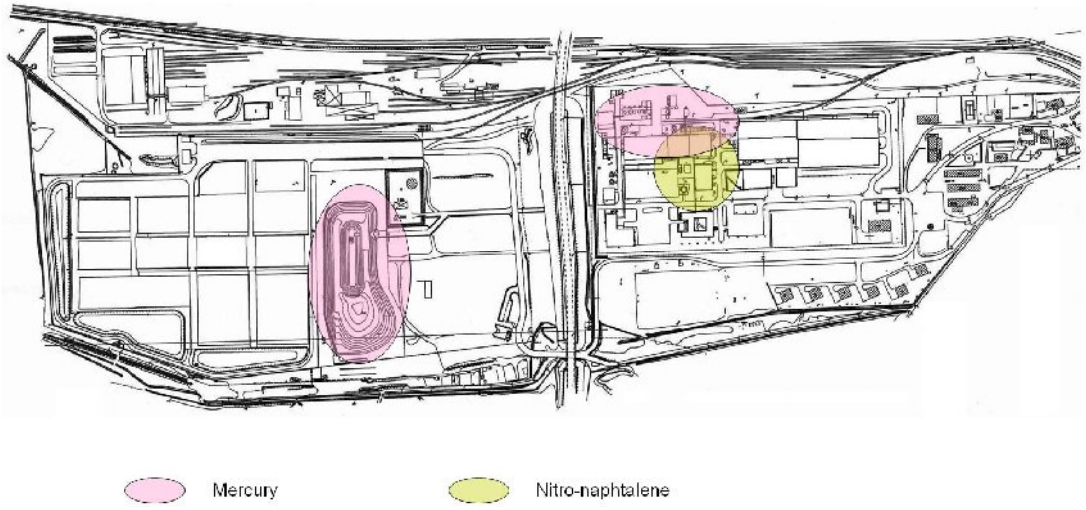

Fig. 2. Environmental footprints of the Miramas Plant

Regulatory elements

On a regulatory level, the project is covered by two prefectural authorizations obtained in early 2010. The first authorization covers all the means used for work (Installation Classified for the Protection of the Environment under French regulations). The second authorization oversees the remediation objectives to be achieved and describes the demonstrations and documentation required to support the achievement of goals.

These two documents cover all elements to be implemented throughout the project. For example, we will find the rules for the use of decontaminated materials. We will also find how to manage and control release of gaseous and liquid wastes. There is also a list of all documents to be submitted during and at the end of the remediation.

Processes

The treatment processes are adapted to the nature of contaminations.

For the Mercury, two processes are implemented:

- The first is a thermal desorption consisting of heating the small particles size of land and materials in order to vaporize the mercury and to recover it by condensation.
- The second is to wash materials of larger particle size to remove the fine material containing Mercury off the surface. In case the required remediation levels are not reached with washing, the materials are crushed and then treated by thermal desorption.

Concerning the organic nitrate compounds footprint, the considered process is a biological processing. The idea is to increase the activity of natural bacteria by injecting air, water and substrates. The contamination is degraded by the bacteria of the natural environment. This process is both technically and economically interesting.

Other footprints will be processed off-site by specialized companies.

Mercury contaminated soil treatment

<u>Excavation and pre-treatment</u>

As indicated above, materials contaminated with mercury are oriented differently depending on their size. Upon excavation, materials are reprocessed by crushing (see Fig. 3.) and screening in order to obtain two size categories which are then oriented to each of the sectors.

Fig. 3. Crushing machine

The grading size chosen for the thermal desorption treatment is between 0 – 30 mm (1.18 in).
The grading size chosen for the scrubbing treatment is between 30 mm – 80 mm (1.18 in - 3.15 in.)

Thermal desorption unit (TDU)

Materials with a grading size of 0 - 30 mm (0 - 1.18 in.) are treated in a thermal desorption unit. This unit is located on a previously dismantled building of the site. This unit has a height of 17 meters, a mass of about 250 tonnes (275 tons) and a capacity of 28,000 tonnes (31,000 tons) per year.

The facility is operating 24 h a day, seven days a week. The materials are processed by batches of between 10 to 12 tonnes (11 to 13.2 tons). They are heated under depression to evaporate the Mercury.

The unit (see Fig. 4.) comprises successively:

- a feeder module (M01) for loading and conveying materials to the first drying module
- a first drying module (M02) to dry soils and materials before the desorption of mercury
- a second drying module (M03) to evaporate the mercury by heating materials
- a module for cooling treated materials (M05)
- a granulation module (M06) for mixing the materials treated with water and binder in order to obtain aggregates with mechanical properties for storage stability.

The auxiliary modules (M04 and M07) are the vacuum production unit and Mercury recondensation unit, the boiler room module and the control station.

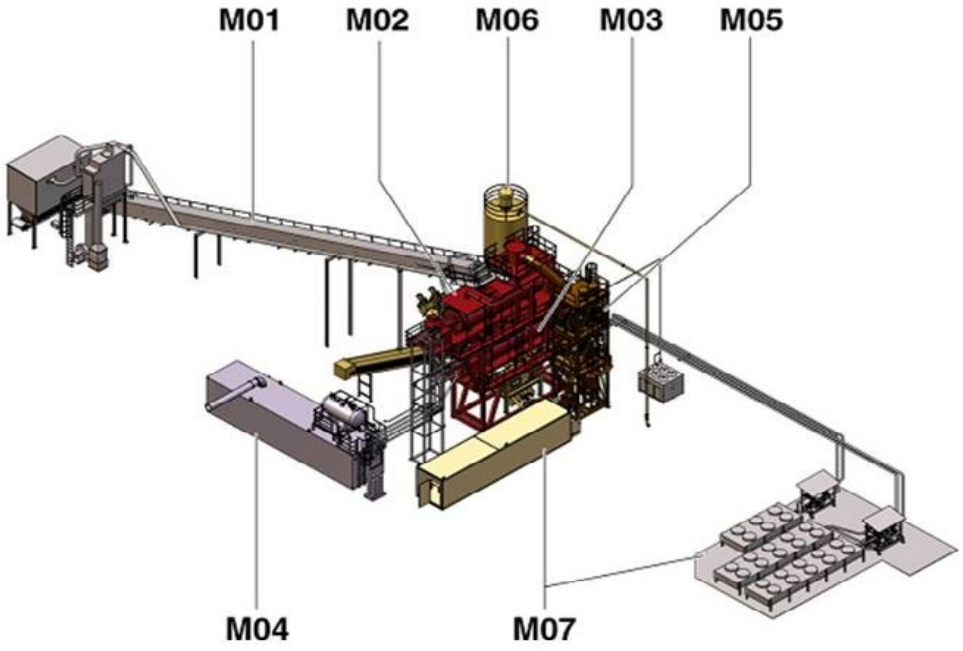

Fig. 4. Thermal desorption Unit

Scrubbing

To optimize the use of the TDU, coarse materials which are generally non contamined are washed to pull away the contaminated fine material. Scrubbing effluents flow in closed circuit to limit water consumption. The fine materials are recovered by settling and then sent to the TDU.

The scrubbed materials are monitored. In case of a failure to reach remediation objectives, they are crushed in order to be treated with TDU. The effluents are treated in an effluent treatment unit specific for mercury contamination shared with TDU (ETP).

Project data

Operations are planned over 5 years from 2010 to 2014. The budget for these operations is approximately €60 million ($81.13 million). This includes operations and operating costs of the site.

The years before 2010 were dedicated to the studies, the TDU pilot and all the administrative procedures and documents. 2010 was devoted to the implementation of the TDU and its peripherals such as the effluent treatment plant and the storage areas for materials to be processed. 2011 was mainly devoted to testing and starting to operate the TDU as well as the implementation of the scrubbing system. The units will be in full operation during 2012 and 2013. 2014 will be devoted to the dismantling of processing units and the development of the final records.

The deconstruction operations are performed in parallel to the environmental remediation operations.

RESULTS

The TDU was commissioned in May 2011. Given that this is a prototype, a break-in period is required. The items being developed are mainly peripheral equipments for loading and unloading materials.

To date, around 10000 m^3 of material have been excavated and screened. The TDU has already processed 7000 tonnes (7700 tons) of soil and materials. The core of the process is effective and all tons produced fulfil the remediation objectives.

Concerning the scrubbing, the first trial confirmed the necessity of important volumes of water. This water has to be treated to pull away fine contaminated material. A dedicated system has been designed and is now under procurement. The whole process should be operational in March 2012

Concerning the biological process, the first tests have verified the possibility of a biological treatment. Nevertheless, there are uncertainties in terms of duration of treatment and non-toxicity of degradation products. An in situ pilot trial is planned beginning of 2012 to deal with these uncertainties.

CONCLUSION

The first successful month of operation at an industrial scale demonstrate that the Thermal Desorption is an efficient and relevant process to remediate large quantity of mercury contaminated soils. The project is on cost and the mercury removal should be end by 2014.

The scrubbing is a good way to limit the volume of material to be treated with the Thermal Desorption Unit.

The biological treatment is a promising process for the organic nitrate compound removal and testing at a pilot scale will be done in 2012.