



LIFE-Environment Demonstration Project : Rehabilitation of abandoned bauxite surface mines using alumina red mud as filler (REFILL)

One of the most challenging problems the alumina industry is facing today, concerns the disposal of the bauxite residues, i.e. the main by-product of bauxite ore processing by the Bayer process to extract alumina. Bauxite residues produced in large amounts worldwide, exit the process stream as a highly alkaline slurry (pH 10-12.5) with low solids content (15-30%) that makes surface disposal difficult. Scope of this project is the development and application of an innovative and cost-effective dry disposal system of bauxite residues, involving their beneficial use for the restoration of the abandoned mining open pits.

Aluminum of Greece, the only aluminum refinery in Greece, located in Agios Nicolaos, Viotia will be used as the case study. The bauxite residues produced by Aluminum of Greece amount to 680.000 tonnes annually and are being disposed on the seabed. Furthermore, a number of abandoned sites from surface exploitation of bauxite ores exist at the wider region close to the plant. Thus the specific objectives of the project include:

- Development and demonstrative application of a dry disposal technique of bauxite residues produced from the alumina refinery in Greece and elimination of the offshore disposal.
- Utilisation of bauxite residues for the rehabilitation of abandoned bauxite surface mines located in the wider area close to the plant.
- Utilisation of other wastes such as waste rock produced from bauxite ore exploitation and sewage sludge for the revegetation of the rehabilitated site.

The project objectives will be accomplished through the implementation of the following tasks:

Environmental characterisation of materials (bauxite residues, waste rock, sewage sludge).

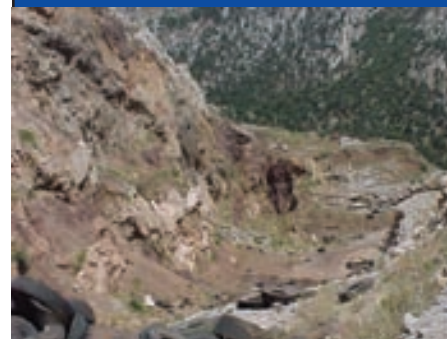
Dewatering of bauxite residues: The major drawback to dry disposal is the large area required to dry the residue. In order to overcome this drawback a high efficiency filter press will be used.

Modification of dried bauxite residues properties and construction of a vegetation cover. For the rehabilitation of the bauxite residues disposal area, the development of a vegetation cover by proper modification of the residue properties is being implemented within this task. This work includes selection of materials to be used as additives in bauxite residues, physical and geochemical testing of the bauxite residues-additives mixtures and vegetation experiments to evaluate the effectiveness of the selected mixtures to support vegetation. It is noted that vegetation experiments (both pot and pilot scale) previously conducted on mixtures of bauxite residue and sewage sludge, gypsum and calcium oxyphosphate have indicated that bauxite residue with properly modified properties can support vegetation.

Demonstrative field application. Field tests covering an area of approximately 15000 m² will be constructed in an abandoned bauxite surface mine. The dried bauxite residues will be deposited up to a thickness of 20 m and will be covered by a layer of dried bauxite residues or waste rock properly modified with ameliorants like gypsum, sewage sludge etc. to support vegetation. Indigenous plants will be planted on the top layer to prevent wind and water erosion, enhance evapotranspiration and improve aesthetics. Lysimeters will be constructed beneath the test area for the collection of leachates. Monitoring parameters of the field tests will include meteorological data, drainage and runoff water volume and quality, moisture, plant growth, metals uptake by plants, dust. The field tests will be monitored for a period of at least one year. The environmental behaviour of dried bauxite residues, when disposed at the surface, is being currently examined in pilot



Pilot test



Abandoned bauxite surface mine

tests, covering an area of 580 m². A couple of test pads having an area of 10 × 10 m and a thickness of 1.6 m were constructed. One test plot was filled with bauxite residues alone whereas in the second a 0.6 m thick layer of waste rock mixed with sewage sludge was placed on top of a 1.0 m thick layer of bauxite residues. The water balance parameters and leachates and runoff quality of the testpads are being monitored. No leachates were collected in the lysimeters after a monitoring period of half a year. This suggests the potential of dried bauxite residues for the successful restoration of abandoned open pits.