A CASE STUDY OF MERCURY REMEDIATION IN A MINING / INDUSTRIAL AREA:
DUMP ALMADÉN MINE

WORKSHOP ON MERCURY IN THE LATIN AMERICAN AND CARIBBEAN REGION
BRASILIA, BRASIL
MAY 21-22 2012
The Almadén mine has been devoted for more than 2000 years to the exploitation and production of mercury, it is well-known that it is one of the oldest mines in the world.

The mercury production activity ended in July 2003.
After the closure, we need the environmental restoration of its dumps, with the aim of minimizing the exploitation effects for more than 2000 years in the environment.
DUMP ALMADEH MINE YEAR
1961
DUMP YEAR 1973
This dump has received for centuries sterile from mining works as well as slags produced during metallurgical processes, reaching a volume close to 3.5 million tons, with a surface of 10 hectares.
ENVIRONMENTAL IMPACT ASSESSMENT

- HYDROLOGIC CONTAMINATION
- ATMOSPHERIC CONTAMINATION
- GROUND OCCUPATION
- GEOFISYS PROCESSES
- GEOTECHNICAL RISKS
- MORFOLOGY AND LANDSCAPE
ACTION ALTERNATIVES

• MOVEMENT AND CONSTRUCTION OF A NEW SAFETY DUMP
  • High environmental and economic impact

• DUMP FORMING AND SEALING
  • Good hydrogeological conditions of the dump
Aims of in situ encapsulation of the dump;

- Stability and landscape integration with the dump and the surroundings
- Securing waterproofing, and isolation from its surface.

The works started in 2005 and ended in May 2008.

Works cost 8,200,000 €
PHASES

DUMP FORMING

Aims:

• Remodel the slopes and the capping plate of the dump

• Stabilizing their conditions

Earth filling of 493.582 m3 of material
2. DUMP SEALING:
Functions:
• To prevent the entrance of water in the dump, avoiding the generation of lixiviates and the material dispersion.
• Insulation, avoiding mercury evaporation in the dump surface.
SLOPE SCHEME SURFACES SEAL

LOW INCLINE
CAPA DE SUELO
GEOCELDAS
GEOCOMPUESTO DRENANTE
BANDA DE POLIETILENO
GEOTEXTIL ANTIPUNZONAMIENTO

SLOPE SCHEME SURFACES SEAL
HIGH INCLINE
SURFACE SEALED ABOUT 20 SOCCER FIELD

GEOCELLS SOUTH SLOPE
The sealing package is composed of:

• 175.250 m² of geotextile

• 139.932 m² of bentonite

• 202.566 m² of high density polyethylene

• 202.116 m² of draining geocomposited

• 100.346 m² of reinforcement geonetting

• 50.000 m² of geocells
PHASES

3. INSTALLATION OF A CAPTURE, CIRCULATION AND EVACUATION WATER SYSTEM

Aim: To avoid the erosive effects which can affect the dump stability
PHASES

4. RESTORATION OF THE VEGETAL LAYER.

AIM:

• To recover vegetation in the restored surface
• The landscape integration of the dump and the surroundings.

ACTIONS:

Contribution of 50 cm of topsoil all over the surface, up to 170,000 m³

Hydroharvest in 16 ha
ENVIRONMENTAL VIGILANCE
PLAN OF ALMADEN MINE DUMPS

Means of different parameters in groundwater, surface water, soil and air.

The predicted length is 50 years
RESTORATION OF THE WASTE HEAP IN THE SAN TEODORO ENCLOSURE

The first results:

Emission to the atmosphere

Measurements in the air during the works (ng/m³)

Measurements in the air after the works (ng/m³)

Fuente: Dr Pablo Higueras (UCLM)
DUMP ALMADÉN MINE
WATER VIGILANCE

The vigilance activities in the postclosing phase of the dumps, refer to the vigilance of waters, mainly:

- Surface waters
- Groundwater

The parameters to control are heavy metals, PH, nitrates, nitrile etc.
DUMP ALMADEN MINE
WATER VIGILANCE

CONTROL SPOTS UNDERGROUND WATERS AROUND ALMADÉN MINE
DUMP ALMADE MINE
WATER VIGILANCE
CONTROL SPOTS UNDERGROUND WATERS: DRILLHOLES

Graphs showing Hg ppb over time for different control spots (SA-1, SA-3, SA-4, SA-5).

- SA-1: Scatter plot with Hg ppb values from oct-05 to oct-11.
- SA-3: Bar graph showing Hg ppb values for specific dates.
- SA-4: Similar to SA-3.
- SA-5: Graph with Hg ppb values for specific dates.

Dates include: ene-05, ene-06, ene-07, ene-08, ene-09, ene-10, ene-11, ene-12.
DUMP ALMADEN MINE
WATER VIGILANCE
CONTROL SPOTS UNDERGROUND WATERS: WELL AND SPRINGS
DUMP ALMADEN MINE
WATER VIGILANCE
CONTROL SPOTS SURFACE WATER. WATERCOURSES

WATERCOURSES FUENTE VIEJA Y AZOGADO
DUMP ALMADEN MINE
WATER VIGILANCE

CONTROL SPOTS SURFACE WATER. WATERCOURSES
DUMP ALMADEN MINE
WATER VIGILANCE
CONTROL SPOT SURFACE WATER. VALDEAZOGUES RIVER

• 9,10 Valdeazogues river
• 15 Azogado watercourse
DUMP ALMADEN MINE

WATER VIGILANCE

VALDEAZOGUES RIVER BEFORE ITS CONFLUENCE WITH AZOGADO WATERCOURSE (POINT 9), AND AFTER THIS (POINT 10)
The restoration actions made

✓ It will reduce drastically the lixiviate production which now have as final destination the surrounding watercourses
✓ It will avoid underground flow inside the dump
✓ It will avoid the material dispersion and mercury evaporation

To follow the works development visit the website:

www.ctndm.es/proyectos/1-in.php
THANK YOU

FOR YOU ATENTION

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