

**SYNTHESIS REPORT  
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PROJECT N°: BE-5551

TITLE : PROJECT FOR THE EXPLOITATION OF RAW MATERIALS  
FOR CLAY ROOFING TILES AND FOR THE BRICK  
INDUSTRY, WITH ENVIRONMENTAL RECOVERY

PRECLAYR

**PROTECT** CO-ORDINATOR : Vittorio VITOLO  
PARTNERS :



INDUSTRIE LATERIZI RIUNITE S.p.A.



**SLT Lining Technology**

**Mining Italiana**

Consulenza Ingegneria Mineraria

REFERENCE PERIOD FROM 07/07/93 to 22/02/96  
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# 1. Index

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<b>2. Index</b>	<b>2</b>
<b>3. Abstract</b>	<b>3</b>
<b>4. Introduction</b>	<b>4</b>
<b>5. Technical description.</b>	<b>6</b>
5.1.1. (Task B) Hydrogeological, Geological and geotechnical analyses aimed at choosing the most suitable sites	6
5.1.2. (Task A) Chemical, physical and mineralogical tests on clays	7
5.1.3. (Task 1) Assessment of environmental compatibility	8
5.1.4. (Task 2) Selection of the filling materials and a study of their chemical-physical-mechanical characteristics	9
5.1.5. (Task 3) Assessment of lining and on-site inertization techniques	9
5.1.6. (Task 4) Study of a mobile covering	10
5.1.7. (Task 5) Mining plan	10
<b>6. Results</b>	<b>10</b>
<b>7. Conclusion</b>	<b>11</b>

## 2. *Title, Authors names and addresses*

FIRST NAME	LAST NAME	POSITION	COMPANY
Vittorio	Vitolo	Project Responsible	Industrie Leterizi Riunite S.p.A.
Stefano	Bolici	ILR Technical Responsible	Industrie Laterizi Riunite S.p.A.
H.W.	Beinssen	SLT Partner Responsible	SLT Lining Technology GmbH
Konrad	Jendrossek	SLT Partner Responsible	SLT Lining Technology GmbH
Yves	Durkheim	GSE Partner Responsible	GSE GmbH
Alessandro	Michelangeli	SLT Sub-Contractor	MICHELANGELI S.r.l.
Massimo	Guarascio	MI Partner Responsible	Mining Italiana S.p.A.
Massimo	Antonietti	MI Technical Responsible	Mining Italiana S.p.A.

FIRST NAME	LAST NAME	ADDRESS	CITY	CAP	PHONE	FAX
Vittorio	Vitolo	Lee. Montemartino	Sinalunga (S 1)	53048	+39 (577) 679105	+39 (577) 679137
Stefano	Bolici	Loo. Montemartino	Sinalunga (SI)	W	+39 (577) 679105	+39 (577) 679137
H.W.	Beinssen	Pollhornweg 17	Hamburg	D-2102	+49 (40) 751006	+49 (40) 7521966
Konrad	Jendrossek	Buxtehuder Strasse, 112	Hamburg	D-211373	+49 (40) 76742	+49 (40) 7674233
Yves	Durkheim	Buxtehuder Straße, 112	Hamburg	D-21073	+49 (40) 7674219	+49 (40) 7674230
Alessandro	Michelangeli	Vi F. Guardi, S6	Cinisello Balsamo (MI)	20092	+39 (2) 66040071	+39 (2) 6170325
Massimo	Guarascio	Piazza Lodovico Cerva,	Roma	00143	+39 (6) 59646316	+39 (6) 5464.6318
Massimo	Antonietti	Piazza Lodovico Cerva,	Roma	00143	+39 (6) 54 .6337	+39 (6) 5464.6318

## 3. *Abstract*

The general activities developed in this project has been to design a type of quarrying activity that:

- uses high-quality materials, following the specification of the most suitable process conditions for the production of roofing tiles and bricks, in relation to the chemical and physical properties of the clay types;
- has a reduced environmental impact, thanks to the adoption of a special mine plan for trances;
- develops the environmental recovery simultaneously with the mining, thus drastically reducing the area subject to visual environmental impact;

- analyses the environmental recovery themes on the basis of the locally available materials that can be used for filling in the **quarried** areas;
- develops the environmental recovery simultaneously using special liners made out of materials that can be used for the filling in of the mining areas;
- studies the technical of a mobile covering system which would totally eliminate the problem of visual environmental impact;
- **allows** the continuation of the quarrying of high-quality clay near to the tile production plant, with the consequent containment of transport costs; an extremely important factor when dealing with a low-value material like clay.
- develops a mining plan for trances that includes immediate environmental recovery during the mining phase, thus camouflaging the work zone as much as possible.
- assess methods and materials for environmental recovery.

#### **4. *introduction***

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The main objectives of the project are listed below:

- **Hydrogeological**, Geological and **geotechnical** analyses, aimed at choosing the most suitable sites

The scope of the first task has been to define the geo-structural characteristics of the geological formations that must be **affected** by the mining. Also, the hydraulic features and the underground and above-ground water systems have been defined.

- **Chemical**, physical and mineralogical tests on clays

The aim of this task has been to **classify** the mined material for the production of clay roofing **tiles** and bricks in order *to assess* the suitability of the potential quarrying sites and to set the size of the mining site.

. Assessment of environmental compatibility

This Task has been aimed to assess the environmental impact of the activities related to the exploitation of the possible test sites with the proposed **innovative** method.

. Selection of the filling materials and a study of their **chemical-physical-mechanical** characteristics

The aim of task 2 has been to **identify** and select the most suitable materials to be used as fillers.

- Assessment of lining and on-site inertization techniques

Task 3 sets out to define the most suitable techniques for the lining and for the on site inertization of the disposed materials. The aim has been to incorporate these operations directly in the productive cycle of the quarry, and not to postpone them until when the quarry is exhausted.

SLT has designed a liner (about 20.000 m') of a pilot landfill. SLT has also explored a way of disposing domestic (municipal) solid wastes to obtain "zero emission" no landfill gas, no **leachate**.

- Study of a mobile covering

The objective of task 4 has been a technical study of mobile coverings to **shield** the quarrying operations **from** view. Methodologies **and** computer simulation programs for detecting and avoiding **future** optical pollution have been developed.

- Mining plan

Task 5 has been aimed to study the mining by trenches method which will allow for the filling with the materials selected in task 2, to be combined with the use of the mobile covering, and with the methods in task 3, in conditions of absolute environmental safety.

- Recovery plan
- Task 6 has been aimed to set out the reclamation operations that will be required when the mining is finished.

## **5. Technical description.**

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The activities carried out in the first 32 months are reported as follows

5.1.1. (Task B) Hydrogeological, Geological and geotechnical analyses aimed at choosing the most suitable sites

Following studies have been performed:

- large scale geology
- overview of the Guazzino area
- stratigraphic succession
- geomorphologic elements
- seismicity
- hydrology
- climatology
- reasons for the choice of the Collilunghi site
- detailed geology
- geognostic and geotechnical surveys
- area stratigraphy and terrain description
- hydrology
- soil permeability to water
- physical and mechanic characteristics of terrain

- study of cutting face stability profile
- monitoring network
- Meteoric data
- Stratigraphy of previous geognostic surveys
- Stratigraphy of geognostic surveys
- Laboratory geotechnical tests

The main achievement of the study has been the development of methodology and availability of field samples.

#### 5.1.2. (Task A) Chemical, physical and mineralogical tests on clays

The following studies have been performed on ten samples of clay extracted from the area. Each sample has been submitted to:

- Mineralogical analysis RX diffraction
- Chemical analysis
- Grain distribution
- TD Thermodilatometric analysis
- DTA Differential thermal analysis
- TG Thermogravimetric analysis
- Total carbonate determination
- Technological tests for the evaluation on drying and firing behaviour
- Recarbonation and efflorescence tests on fired products.

The main achievement of the study has been the assessment of the possibility to employ these materials for heavy clay products: (sample 1214-1, 1214-5 hand made brick). Other materials should be employed for tiles, hallow brick production.

The Task A must be repeated for a new Project in a different **site**. The methodology will be the same.

#### 5.1.3. (Task 1) Assessment of environmental compatibility

If the **field** activities would be **carried** out *in a new* Project software and main methodologies developed in the previous site are **fully** in operation and available for every similar site. The achievement was **the fully** development of the methodology of the approach.

A complete study of the environmental impact **has** been performed for the selected site; the main activities are listed below.

General aspects

- **General** information

Programme reference outline

- Proposed project

- The project with regard to present planning activities

Project reference outline

- Technical characteristics of the project

Geological aspects

- Geological setting

- Analysis of geological and **geotechnical** aspects

Environmental reference outline

- Environmental factors concerned with **the** proposed project

- **Analysis** of environmental factors **and** evaluation of effects

- Results of assessment of project's effects



The main achievement of the project has been the assessment of the environmental suitability of the project.

#### 5.1.4, (Task 2) Selection of the filling materials and a study of their **chemical-physical-mechanical** characteristics

The detailed study is reported **in** previously **quoted** annexes; the main aspect investigated have been:

- general characteristics
- rules and regulations
- filling materials wastes (domestic and other)
- definition of parameters and characteristics necessary to choose product mixes
- waste already reused within the productive **cycle**
- user areas **involved** in the project
- **further** remarks
- remarks concerning the provincial plan for waste disposal and its possible **future** developments

The main achievement has been the methodological approach that can be used in a different site.

#### 5.1.5, (Task 3) Assessment of lining and on-site inertization techniques

HDPE Liners have mechanical, chemical and biological characteristic that **can** be considered as the more suitable material available in the market.

These sheets have to **fulfil** mechanical requirements for waste content in solid block cells.

### 5.1.6. (Task 4) Study of a mobile covering

The aspect investigated have been:

- . studying motivations and environmental situation
- . methodology used

The conclusion of these works was that is possible, by **a** geometrical point of view, **to** reduce the optical impact of excavation works.

The graphical approach used (terrain **modelling**, evaluation of most sensitive views, excavation **modelling**, evaluation of covering position and **geometry**) resulted fast, easy to use and cheap. In addition it is very easily applicable to other similar problems of optical impact.

### 5.1.7. (Task 5) Mining plan

In case of different site **software** and methodology will be the same.

## 6. *Results*

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### • **Hydrogeological, Geological and geotechnical analyses aimed at choosing the most suitable sites**

The main achievement of the study has been the development of methodology and availability of field samples. This Task must be repeated for every new possible **localisation** of the project.

### • **Chemical, physical and mineralogical tests on clays**

The main achievement of the study has been the assessment of the possibility to employ these materials (coming from **Sinalunga** area) for heavy clay products: (sample 1214-1, 1214-5 hand made brick). Other materials should be employed for tiles, hallow brick production.

- **Assessment of environmental compatibility**

**Software** and main methodologies developed in the selected site are fully in operation **and** available for every similar site. The achievement was the **fully** development of the methodology of the approach.

The main achievement of the project has been the assessment of the environments! suitability of the project in area similar to the previously predicted.

- **Study of a mobile covering**

The conclusion of these works is that is possible, **by** a geometrical point of view, to reduce the **optical** impact of excavation works.

- **Mining plan**

In different site **software** and methodology **will** be the same.

## **7. Conclusion**

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The research carried out highlights the tangible possibility to **realise** the project currently being studied, **In** fact, the hypothesis of filling quarries with waste during the quarrying activities is quite welcome, also considering the substantial **amount** of materials existing in the area which today have to be dumped or disposed of by means of other expensive techniques.