

OF SERVICES

PG. 2

Preliminary identification of potential clay candidates to be used as Supplementary Cementitious Material

PG. 3

Assessment of reactivity of the clay candidate chosen for use as Supplementary Cementitious Material

PG. 5

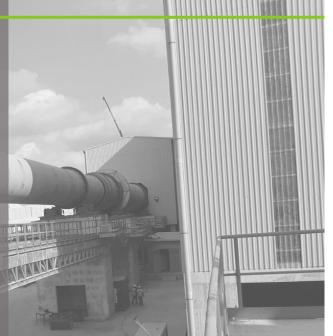
Realization of an **industrial for calcination and grinding trial** for the production of cement with calcined clay



contactus@ecosolutions.gl



www.ecosolutions.gl



"More than 40 years of experience in consultancy and implementation of projects for sustainable habitat"



grupo sofonías asesoria en desarrollo integral actions in integrated development



Report #1: Identification of potential candidates to produce calcined clay as Supplementary Cementitious Material.

- 1. Chemical composition of the clay in oxides
- **2. Mineralogical composition** expressed in the main crystalline phases in the material, determined using X ray diffraction techniques, XRD.
- 3. Thermo-gravimetric studies of the material.
- **4. Geological information available** on the clay deposit, especially the lithology of the spot where samples were collected, and their geo-referenced location.

Description: The work will be done with existing information on clay deposits surveyed in the past, or any other studies carried out in the region on the pursuit of other minerals and resources, where chemical and mineralogical information can be obtained, as well as information on the geology of the region. Such information should come from the client, but Ecosolutions can also access it on the public domain.

Implementation: 4 weeks from the moment the information is received

Number of candidates covered in this study:

Up to 5 candidates. **NOTE:** if the client wants to incorporate further candidates there is an extra cost associated.

Expected results:

Individual assessment of each clay candidate (clay deposit) and further criteria on its viability for the production of SCMs, based only on data from chemical and mineralogical composition and the geological history. These results are very preliminary and must be ratified in further phases aided with experimental studies.



Report #2: Reactivity of the clay candidate as Supplementary Cementitious Material

1. Accompanying the local geology team at sampling during the exploration of the deposit. **A minimum area of 100 ha will be studied**, to guarantee reserves at least in the order of 1 Mt of clay.

sampling the clay deposit of interest, through the collection of individual samples and/or composite samples, that can be used to produce a representative sample of the entire deposit, which can also be evaluated.

Implementation: Sampling: 4-6 weeks

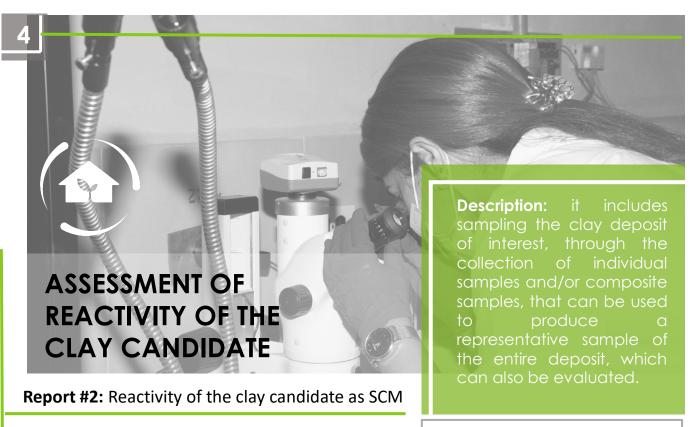
A sampling grid with spacing 250m x 250m will be defined. In each intersection of the axis of the grid individual samples shall be taken, either in trenches or as boreholes. For each individual axis a composite sample shall be prepared through blending of individual samples. Sampling depth will be dictated by the geology of the deposit. A typical study in a 100ha area would produce 25 individual samples, 5 composite samples and 1 integral sample, for a total of 31 samples. The client can change the sampling design for own purposes, at an extra cost.

Number of samples covered in this study: 31.

NOTE: further simples can be tested upon request; this implies an extra cost.

Expected results:

Full **characterization of the material available** at the clay deposit subject of interest, including **chemical and mineralogical composition**, kaolinite content, potential reactivity as SCM and physic-mechanical properties in LC3-50 systems (50% clinker, 30% calcined clay, 15% limestone, 5% gypsum)



2. For each of the samples collected the following experimental program shall be undertaken:

Implementation: Sample evaluation: 6-8 weeks from the point of arrival of the simples to the lab.

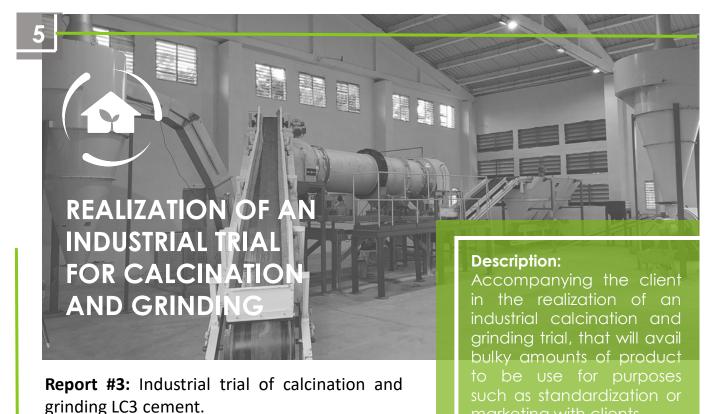
- a. Chemical and mineralogical composition.
- b. Determining kaolinite content through the combination of thermal analysis and X ray diffraction.
- c. Lab calcination at 800°C, with quality of calcination controlled using TG.
- d. Assessment of reactivity[1] through:
 - ✓ Evaluation of heat of hydration at 72h in an isothermal calorimeter of a cement paste with composition of LC3-50 (53% CEM I 42,5 N, 30% calcined clay, 15% limestone, 2% gypsum)
 - ✓ Strength at 24h, 7d and 28d in standard mortars with composition of LC3-50 (53% CEM I 42,5 N, 30% calcined clay, 15% limestone, 2% gypsum)

Number of samples covered in this study: 31.

NOTE: further simples can be tested upon request; this implies an extra cost.

Expected results:

Full characterization of the material available at the clay deposit subject of interest, including chemical and mineralogical composition, kaolinite content, potential reactivity as SCM and physic-mechanical properties in LC3-50 systems (50% clinker, 30% calcined clay, 15% limestone, 5% gypsum)



1. Accompanying the geology team at sampling of an industrial sample of the average material at the clay deposit, which should be representative of the entire deposit. Sample size oscillates between 1-1000 t, depending on the client's interest and the industrial facilities available.

Implementation:

(it depends on the activities) Characterization of the industrial sample: 4-6 week.

- **2.** Characterization of the industrial sample, using a protocol like the one described in section 2
- a. Chemical and mineralogical composition.
- b. Determining kaolinite content through the combination of thermal analysis and X ray diffraction.
- c. Lab calcination at 800°C, with quality of calcination controlled using TG.
- d. Clay reactivity in cementitious systems of the kind LC3

Number of samples covered in this study:

1 sample (although there can be replications)

Expected results:



REALIZATION OF AN INDUSTRIAL TRIAL FOR CALCINATION AND GRINDING

Report #3: Industrial trial of calcination and grinding LC3 cement.

- **3.** Realization of an industrial trial in any of the following facilities:
- a. Ecosolutions' Pilot Plant at Santa Clara, with calcination capacity of 150 kg/h under strictly controlled conditions, including color control of the resulting product. In this case the sample size oscillates between 400-800 kg, depending on the client's interests.

Description:

Accompanying the client in the realization of an industrial calcination and grinding trial, that will avail bulky amounts of product to be use for purposes such as standardization or marketing with clients.

Implementation:

Realization of the industrial trial: 4-6 weeks from the point the samples arrive at the Pilot Plant.

- b. Existing clinker or lime kilns, depending on the clients' possibilities for the calcination of the material under the designated conditions (gas temperature between 800-900°C, minimum residence time 40 min)
- c. Other facilities available for the client, where a calcination trial can be carried out. For example, an intermittent brick kiln with temperature control would eventually do.

Number of samples covered in this study:

1 sample (although there can be replications)

Expected results:



- **3.** Evaluation of quality of calcination and reactivity of the calcined material, using the same protocols described in section 2.
- a. Quality of calcination
- b. Reactivity of the calcined clay in LC3 cementitious systems

Implementation:

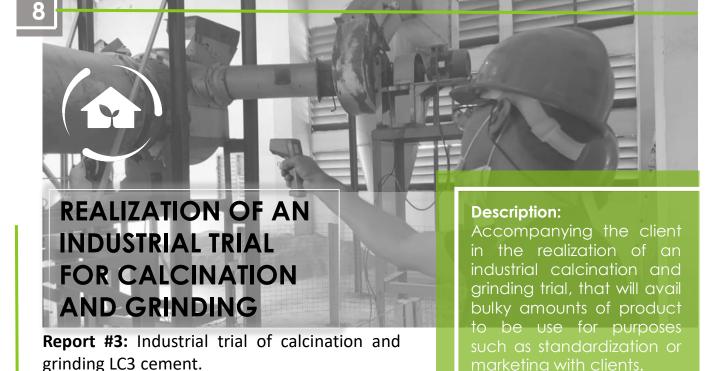
Realization of the industrial trial: 4-6 weeks from the point the samples arrive at the Pilot Plant.

- 4. To guarantee conditions for the realization of an industrial grinding trial (ball mills or similar), which enable grinding the material to fineness equivalent to 3% retention at the 90 μ m sieve. These could be:
- a. Ecosolutions' Pilot Plant at Santa Clara, with grinding capacity 100 kg/h in an open circuit ball mill with air extraction of the product.
- b. Any other grinding system that guarantees the demanded conditions.

Number of samples covered in this study:

1 sample (although there can be replications)

Expected results:



- **5.** Realization of an industrial trial in any of the following facilities:
- a. Mineral addition "LC2", which consists of 60% calcined clay, 35% limestone and 5% gypsum. LC2 has a long shelf life, and can be blended with CEM I 42,5 or CEM I 52,5 in different proportions to produce diverse LC3 formulations.

Implementation:

Realization of the industrial trial: 4-6 weeks from the point the samples arrive at the Pilot Plant.

- b.LC3 cement properly, according to the formulation demanded by the client (clinker content)
- c.Both products will be produced in two batches: (i) calcined clay with color control (black), and (ii) calcined clay without color control (red)
- **6.** Assessment of quality of grinding and the properties of the ground product using international standards of the interest of the client.
- a. Cement fineness, according to the requested standard.
- b.Compressive strength in standard mortars, according to EN-197

Number of samples covered in this study:

1 sample (although there can be replications)

Expected results: