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Integration of a novel mechanical sand reclamation technology in a steel foundry to maximise SFS valorisation in foundry and construction applications

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ABSTRACT

One of the most pressing environmental concerns that metal casting industry faces nowadays is the disposal of Spent Foundry Sand (SFS). Landfill of foundry sand remains a severe environmental problem in Europe, not because of hazardousness of waste, but due to its significant quantity.

The approach taken in LIFE ECO-SANDFILL project involves turning waste from the casting industry into useful feedstock for foundry and other industrial sectors, leading to reducing landfill of waste and decreasing the environmental impacts associated with disposal and extraction of non-renewable mineral resources. To this end, a prototype of a novel mechanical SFS reclamation system has been constructed and integrated in the moulding sand circuit of a steel foundry located in the Basque Country (ES). The SFS generated in the foundry is treated in the prototype to remove impurities from binders and the casting process and to make the reclaimed sand reach the required quality for the different applications envisaged in the project. The environmental, technical and economic performance of the solution is planned to be validated in three full-scale case studies to be executed in the construction works for the Madrid-Irun High-Speed Railway Network, in the vicinity of the foundry, and through a pilot casting trial of steel parts in the foundry itself, using reclaimed sand in the manufacture of the moulds.

This paper describes the preparatory activities carried out before executing the casting and construction demos, focused on dosage studies and characterisation tests of a series of sand samples and specimens manufactured using SFS (untreated and reclaimed) in their formulations. From the chemical analysis results, it has been concluded that the reclaimed sand obtained in the prototype coupled to the sand circuit of the foundry fulfils environmental conditions for construction applications and could be safely used in mortar, CLSM and embankment demos, provided that applicable technical requirements are met. In the case of foundry applications, it has been found that reclaimed sand does not meet the stringent specifications for coremaking, but it might be a partial replacement for the thermally recovered sand used as facing sand in moulds (PEP-SET system).

KEYWORDS
Spent Foundry Sand, SFS, Moulding Sand Reclamation, Secondary Aggregates, Waste Recovery, Circular Economy,

INTRODUCTION

Spent Foundry Sand (SFS) generation is intrinsic to metal casting processes. Most of the ferrous foundries use sand moulds and cores for casting, which are discarded after pouring. That practise generates large amounts of waste sand, representing approximately 60-85% of total solid waste from foundry. According to statistics from CAEF, the European Foundry Association, about 1900 ferrous foundry units were active in 2016 in Europe [1]. There are no accurate records on a European level of annual amounts of ferrous foundry sand waste, but it can be estimated in the range 4.5–9 Mt/yr [2]. Only 25-30% of that waste sand is recovered in a few applications, namely in cement industry, agricultural soils and landfill covering, and the remaining percentage is still landfilled. That situation offers an opportunity to seek new valorisation alternatives to divert non-hazardous sand waste from landfill and deposit.

Use of SFS as secondary fine aggregates in a material intensive sector such as construction offers promising valorisation options. The sand must meet technical specifications relevant for each application and, additionally, fulfil several environmental conditions for unbound uses, where the sand is directly in contact with the soil. The EU-funded LIFE ECO-SANDFILL project is investigating the use of SFS as fine aggregate in construction applications, specifically for geotechnical applications (embankments) and for flowable mortars and Controlled Low Strength Material (CLSM). The potential for high-quality reuse in foundry is being evaluated also.

MATERIALS AND METHODS

SFS flows for valorisation

Steel foundry FUNDICIONES DEL ESTANDA, S.A. employs two types of sand in their moulding shop: green sand (using bentonite as binder) and chemically bonded sand of the “Phenolic-Isocyanate" type. After casting and metal parts demoulding, the sand from used moulds and cores enter sand treatment and regeneration circuits in the foundry. The primary recovery circuit of the green sand at ESTANDA consists of vibrating sieves, magnetic separator, polygonal sieve and sand cooler. In the case of used chemically-bonded sand two levels of recovery are applied:

- Primary regeneration, consisting of mechanical treatments to break down and particulate sand from moulds and cores back to its original grain size, separating foreign materials (metal, sand lumps, plastic elements…) and fines, and of a chromite separation step. The silica sand recovered still retains spent binder, which coats partially the sand grains.
- Secondary regeneration: approximately 15% of the primarily regenerated sand is further processed by thermal reclamation. The remains of binder layer are burnt and the silica sand obtained is of the quality required to be used as facing sand in moulds.

In the first stages of the LIFE ECO-SANDFILL project, the characteristics of two waste sand flows of the foundry have been studied: **surplus green sand (GREEN SFS)** and **chemical circuit purged sand (CHEM SFS)**, which are periodically extracted from their respective circuits, to freshen the recirculating sand flows, and are landfilled. Samples of those two SFS streams have been subjected to reclamation adjustment trials on a demonstration plant at ONDARLAN, S.L., in order to: (i) quantify the degree of impurity removal obtained by the novel reclaiming technique; and (ii) select the optimal levels of operation variables to run the

reclamation prototype on industrial conditions to produce sand of the required quality for the envisaged demos in foundry and construction applications.

Description of SFS Reclamation Technique

The new reclamation technique integrated and tested in ESTANDA foundry consists in scrubber style reclamation with centrifugal force, in which the sand is rubbed together and against the walls in a closed system, removing effectively impurities from the surface of the silica sand. One of the advantages of this technology is the versatility, as it can be re-adjusted according to the characteristics of the sand (composition and binder) and the specifications requested for its final application. The main components of a sand reclaimer of that type are:

1. ATTRITION CHAMBER: cylindrical body, where SFS is fed and mechanically attrited. Operational variables that control the attrition process:
   - amount of SFS entering the chamber (batch size, kg).
   - residence time or treatment time inside the chamber (sec).
   - rotation speed of the attrition chamber (rpm)
2. FLUIDISED BED: located below the attrition chamber. When the SFS treatment cycle (mechanical attrition cycle) is over, the treated sand is discharged to the fluidised bed, and a new load of SFS is let into the attrition chamber to initiate a new treatment cycle. An air stream from the outside is conducted to the fluidised bed by means of a fan, which separates the heavier particles of recovered sand from the finer (dust) while the recovered sand is advancing towards the fluidised bed outlet. The air flow and fan power are kept constant throughout the fluidisation process. Reclaimed sand is collected at the outlet of the fluidised bed. The operational parameters that can be adjusted in each run are air flow (m^3/h) and fan power (kW).
3. CYCLONING BODY: in the ascending of the fines during fluidisation phase, a first separation of fines occurs into the cyclone, separating fines (dust) from the heaviest grains of the recovered sand going to the outlet of fluidised bed.
4. DUST EXHAUSTING FILTRATION: a fines filtration equipment is placed at the end of the sand reclaiming process, consisting basically of horizontal filter sleeves, that are periodically cleaned by means of compressed air actuated by solenoid valves, and driven by a fan which produces a constant vacuum suction. This filter retains the dust of the process, which is extracted by means of a screw and alveolar valve and is discharged on a container. Two operational variables can be adjusted at this stage:
   - Air flow (m^3/h) and dust extractor fan power (kW)
   - Pressure drop (mm H_2O)

In the project, the prototype features and components have been adapted to the existing installations at ESTANDA, to the input sand (CHEM SFS) properties and to specifications requested to the reclaimed sand and have followed ecodesign guidelines. The custom-built reclamation prototype constructed by ONDARLAN (nominal treatment capacity = 5 t/h) has been coupled to the existing recovery circuit of the chemical sand, in a point after the primary regeneration system, so that the primarily regenerated sand can be diverted into the LIFE ECO-SANDFILL reclamation equipment on demand and the prototype's sand output can be either

- conveyed to the backing sand or facing sand silos of the foundry's moulding shop, depending on sand quality;
- collected in container for uses out of the sand circuit of foundry (construction aggregates).

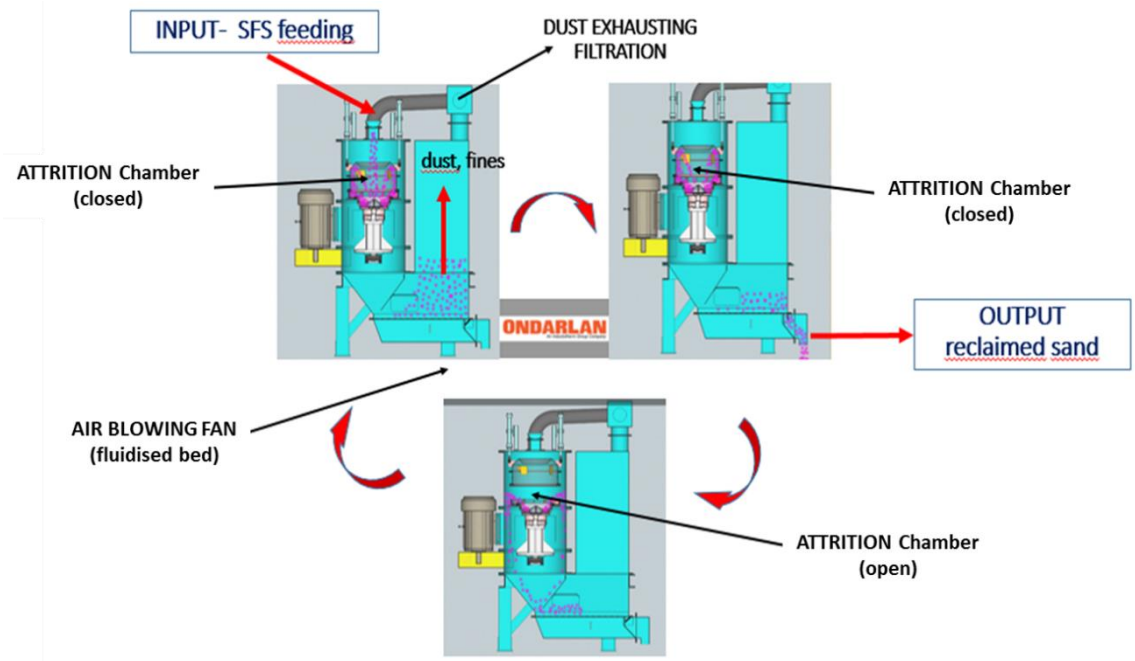


Figure 1. Operation cycle of SFS reclaiming technology applied in LIFE ECO-SANDFILL

Demonstration of SFS valorisation in construction

Demonstrators in real construction environment have been planned to validate the quality of waste foundry sand from ESTANDA (further reclaimed or not) to be used as fine aggregates in several construction applications, as a replacement of natural sand; and to define the best use conditions and substitution ratio in the formulation of the products, in order to optimise product performance from the technical, economic and environmental point of view. Three demos are designed that will meet specifications requested for infrastructure works on the worksite of a section under construction of the High-Speed Train Madrid-Irún railway network, located approximately 20 km away from the foundry installations:

1. **Controlled Low Strength Materials (CLSM)** for backfilling applications. CLSM is a flowable, self-compacting, low strength mortar, typically consisting of a mixture of 1700/100/200-350 kg/m^3 of sand/cement/water, respectively; designed to backfill voids or trenches in urban repair works or underpasses for tracks in the railway network. For such applications, manufactured CLSM is requested to guarantee Uniaxial Compressive Strength (UCS) of 1 MPa.
2. **Flowable filling mortar** for non-structural applications, such as tunnel concrete coverings, filling in pumping well and decanting pool, or backfilling mortar in foundation slabs of embankments. The requested value of Uniaxial Compressive Strength for those applications is 15 MPa.
3. **Embankment.** Use of SFS as granular filling material for embankment construction with no liners to encapsulate them, demonstrating technical performance (compaction properties, loading capacity, stability…) and non-existence of environmental risks (leaching issues). The engineering requirements for granular filling material to be used for embankment constructions are laid down in Spanish regulations on Road and Bridge Works (*Pliego de Prescripciones Técnicas Generales para Obras de Carreteras y Puentes (PG-3) - Part 3, Art.330*).

The execution of the demos on a real worksite requires an Authorisation for a Pilot Experience by the Department of the Environment, Territorial Planning and Housing of the Basque

Government (ES). The application for the authorisation must include a detailed description of the demos and the results of standardised characterisation tests of the waste to be valorised, performed by accredited laboratories, proving that it complies with environmental and technical conditions applicable. Given that SFS valorisation in construction sector is not specifically addressed in any regulation at European or local level, the conditions set out in existing regulations in the Basque Country on valorisation of recycled aggregates from construction and demolition waste [3] have been used as a reference:

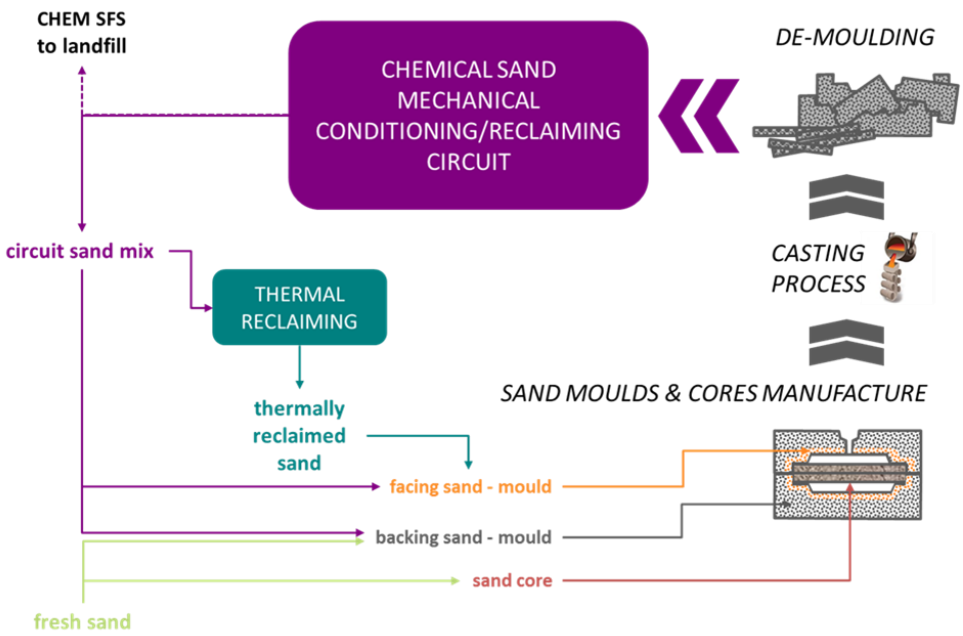
- recycled aggregates intended for unbound applications (embankment) must fulfil relevant technical requirements (Art.330, PG-3) as well as the following environmental conditions: meet leachate limit values for inert waste landfilling [4] and contaminant concentration limit values stated in soil pollution regulation [5];
- secondary aggregates in hydraulically bound applications: no environmental conditions given; foundry sand must meet applicable technical requirements for aggregates in specific standards or regulations:
  - Flowable filling mortar: UNE EN 13139 technical specifications for mortar aggregates
  - CLSM: no UNE or EN standard available; specific construction site requirements applied to fine aggregates for the intended application

In parallel, ACCIONA has conducted experimental tests to investigate the optimal conditions of use of waste foundry sand in bound and unbound applications, to guarantee meeting technical requirements while maximising the amount of SFS valorised. The performance (workability, durability, mechanical resistance…) of different dosages of cement, water, natural sand and SFS (untreated and reclaimed in the prototype) has been studied; as well as compactability and bearing capacity of SFS as tolerable soil in the core and foundation of embankments.

Demonstration of reuse in foundry applications

ESTANDA applies a NO BAKE system, the so-called PEP SET system, with binders based on a poly addition reaction between a phenolic resin and an isocyanate component. PEP SET involves a three-component system consisting of a binder (part 1), a hardener (part 2) and a liquid catalyst (supplier: ASK Chemicals). The foundry follows two mould manufacturing programmes for producing different series of castings (brake discs and cement industry components). Differences are basically in the composition of the sand mix in the sand flow to the mixer and in the mass ratios of sand and chemical binders to form the "facing sand" part of the mould. Three types of sand from the circuit are used in different proportions in the mixtures (Figure 2): thermally reclaimed sand ('TR sand'), primarily regenerated sand ('MR sand') and a small percentage of fresh sand ('new') —added in order to 'freshen' the circuit mix and prevent it from degrading over successive recovery cycles.

A casting trial is planned to validate eventually the use of sand reclaimed in the LIFE ECO-SANDFILL prototype in the sand mixtures to manufacture moulds. Previously, lab scale research is being conducted to select the most promising mixture and the best mould manufacturing conditions. Eight formulations have been proposed in which different portions of the three grades of sand are mixed together. Dosage of binders and catalyst is modified as needed to meet ESTANDA's requirements of strip time and bench life in their mould manufacturing programmes. The formulations have been used to prepare standard specimens for mechanical tests to investigate the effects of reclaimed CHEM SFS additions on mechanical properties (flexural strength, scratch hardness) of no-bake resin bonded moulding sand.



CHEM. bonded sand	Fresh (new)		Thermal reclam.		Primary mech.reclam + chromite separation	
CORES	100%		0%		0%	
MOULDS	0%	10%	100-50%	0%	0-50%	90%
	FACING SAND	BACKING SAND	FACING SAND	BACKING SAND	FACING SAND	BACKING SAND

Figure 2. Mixture of sand grades used in moulds and cores in the chemically bonded sand casting line at ESTANDA (before LIFE ECO-SANDFILL prototype)

Table 1. Sand mix formulations of specimens for testing mechanical properties of moulds

Formulation ID	S01	S02	S03	S04	S05	S06	S07	S08
TR sand	100%	0%	0%	50%	0%	50%	75%	25%
MR sand	0%	100%	0%	50%	50%	0%	0%	25%
ECO-SANDFILL	0%	0%	100%	0%	50%	50%	25%	50%

RESULTS

Selection of optimal SFS reclamation conditions

Design of Experiments techniques were used to choose 20 combinations of reclamation process variables at different levels to run a series of experiments on a demonstration plant at ONDARLAN, aimed at adjusting the process to the characteristics of the SFS (GREEN and CHEM) generated by ESTANDA and achieving the final quality required for the foundry and construction applications.

Output samples taken from every reclamation trial were analysed by IK4-AZTERLAN for a set of parameters established as cut-off criteria: Lost on Ignition (LOI), particle size (AFA fineness number and % fines), % soluble chloride and sulphate, bentonite content (Methylene Blue) and moisture. For each reclamation run, the percentage of rejects (exhaust dust collected) by mass of SFS fed was measured. SEM-EDS analysis of samples of sand provided a tool to evaluate

by visual inspection the extent of the surface cleaning of the sand grains, to spot foreign particles and to determine semi-quantitatively chemical composition. The results indicated:

- CHEM SFS: all reclaimed output samples met cut-off specifications for the envisaged construction applications and mould manufacturing in foundry. LOI and fines requirements for coremaking were not achieved. Reclamation yield > 95%.
- GREEN SFS: all reclaimed output samples met LOI & AFA, but did not meet % fines specifications for coremaking and mould manufacturing in foundry. Cut-off criteria for construction were met. Reclamation yield 80-90%
- Drop in LOI values between 60% and 30% achieved in CHEM SFS and 65%-80% in GREEN SFS, with all final LOI values of reclaimed SFS <1%.
- Moderate increment in fineness of CHEM SFS after reclamation trials (AFA number grown by 0.5-2 units), but considerable in reclaimed GREEN sand (AFA number risen by 10-20 units and fines content by 400%-1500%)

Figure 3. LIFE ECO-SANDFILL reclamation prototype installed at ESTANDA (left) and compared SEM images (100x magn.) of chemically bonded SFS before (right, top) and after treatment in the system (right, bottom)

Considering the observed results, the range of operation variables of the reclaiming process that allow to optimise the degree of cleaning achieved on the SFS, combining highest productivity and recoverability quality of reclaimed sand are established as:

- SFS type: chemically bonded sand primarily regenerated, periodically purged from ESTANDA's chemical sand circuit (CHEM SFS)
- Attrition chamber loading capacity: 60-70% (Batch size: 60-70 kg)

- Rotation speed of the attrition chamber (motor): 2000-2500 rpm
- Cycle time (residence time in attrition chamber): 60-90 s
- Number of reclaiming cycles: 1
- Stable air flow conditions (fluidised bed): fan power = 3.7 kW
- Stable Pressure drop (fluidised bed) = 160 – 180 mm H_2O
- Stable air flow conditions (dust exhausting equipment) = 5400 m^3/h.

Through the application of multicriteria analysis, GAIKER-IK4 ecodesigned the optimal operating conditions of the reclamation process of CHEM SFS, by reconciliating best properties in the sand obtained and minimal environmental impact of the reclamation process (in terms of Global Warming Potential, Abiotic Depletion, Ozone Layer Depletion Potential, Acidification, Eutrophication and Photochemical Ozone Creation Potential). Under those hypotheses, the best operational conditions were set at: batch size = 60 kg, rotational speed of the motor of the attrition chamber equal to 2235 rpm and residence time = 60 s.

Those recommendations were taken into account in ONDARLAN's designs for constructing and operating the custom-built reclaimer prototype to be attached to ESTANDA installations. Due to operational constraints stemming from the connection to the foundry sand circuit, the final operation of the reclamation prototype on industrial conditions was adjusted to a batch size of 42.3 kg (loading time = 15 s), reducing the treatment capacity of CHEM SFS on the prototype during project demos down to 1.8 t/h.

Characterisation of SFS as aggregates for construction demos. Optimisation of dosage

Four grades of sand taken from the foundry were analysed by IK4-AZTERLAN and ACCIONA to check if they complied with the environmental and technical conditions set by Basque Public Authorities for executing the construction demos:

- Surplus green sand (‘untreated’ GREEN SFS) and chemically bonded sand (‘untreated’ CHEM SFS) extracted from ESTANDA’s moulding sand circuits
- Reclaimed GREEN and CHEM SFS, treated in the reclamation equipment assembled by ONDARLAN

The environmental analytics indicated that the concentration of potential contaminants/hazardous substances in chemical composition of all the sand samples were always below regulated limit values, but the environmental conditions in their eluates (leaching tests) were only fulfilled in the case of CHEM SFS reclaimed in the prototype. Therefore, that sand could be safely used in bound (mortar, CLSM) and unbound applications (embankment) in the construction demos, provided that the corresponding technical requirements were also met. In this regard,

- Technical requirements for soil in embankment (PG-3): tests carried out by ACCIONA determined that reclaimed CHEM SFS met the limit values for tolerable soil to be used in the core and foundation of embankments (CBR ≥3). The modified proctor showed a dry density / optimum moisture content of 1.78 t/m^3 / 10.0%. However, SFS shows discontinuous grading and spherical shape that compromises the compactability and embankment stability. For this reason, it has been proposed to blend it with borrow material at an 80:20 ratio.
- The properties specified in UNE-EN 13139 for aggregates for mortars (threshold and declared values) were determined by an accredited laboratory on the reclaimed CHEM sand. Measured values on the sand were below threshold values, except for fines content

and volume stability (as water soluble substances). The measured alkali-silica reactivity (declared value) indicated potential reactivity. Those results recommended designing the mortar demo in a temporary non-structural application on the worksite.

Table 2: Characterisation of reclaimed CHEM SFS according to PG-3 Art.330

Property	Limit Value (tolerable soil)	Reclaimed CHEM SFS
Organic Matter	<2%	0.66
Gypsum Content	<5%	0.31
Soluble Salts	<1%	0.06
CBR Value (Foundation & Core)	>3	5.1
Liquid Limit (if Plastic)	<65	Not plastic
Plasticity Index (if Plastic)	if LL>40 , PI>0,73*(LL-20)	Not plastic
Collapse	<1%	0,09
Swelling	<3%	1.9

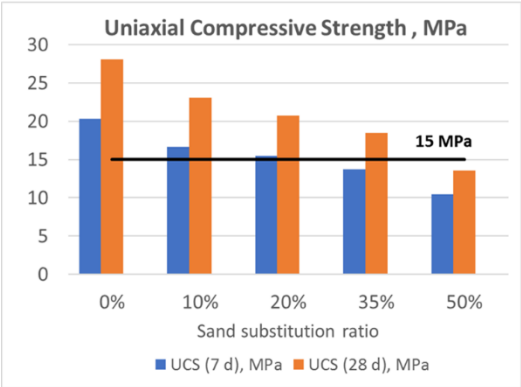
Apart from characterising the sand as fine aggregates, it is necessary to define the maximum substitution ratio achievable in the hydraulically bound applications (mortar, CLSM). To this end, ACCIONA has performed a dosage study, varying the quantities of cement, water, setting additives, natural sand and SFS. Raw materials and admixtures used on the real infrastructure worksite to host the demos have been used in the study:

- UCS values over 2 MPa were measured at 28 days for mixtures of CLSM with 100% substitution of natural sand with reclaimed CHEM SFS. It guarantees fulfilment of the target UCS set by ACCIONA for the CLSM applications in the project (>1 MPa) and, consequently, 100% substitution ratio would be used for CLSM demo applications.
- Reclaimed CHEM SFS used as substitute fine aggregates in mortar mixtures with sand substitution ratios >50% caused high cement consumption, growing water demand and a 10% reduction of uniaxial compression strength after 28 days (versus UCS after 7 days). That observed loss in mechanical performance advised against the use of higher substitution ratios if the durability and resistance of the mortar application were to be secured. From an economic view point, reclaimed CHEM SFS dosages >50% required higher consumption of cement, water and additives and, so, mortar manufacturing costs rose.

Table 3: Dosages tested in laboratory for mortars and CLSM to be used in demos

Components in 1 m^3, kg	Mortar	CLSM
Cement 42.5R (high UCS at early ages and long-term)	350	200
Water	300	257
Natural Sand	675	-
Reclaimed CHEM SFS	680	1337
X-Seed Additive (hardening accelerator)	19	10
Density (kg/m^3)	2.1	1.8
Uniaxial Compression Resistance at 1 day (MPa)	3.09	0
Axial Compression Resistance at 7 Days (MPa)	22	2.3
Axial Compression Resistance at 28 Days (MPa)	20	2.4

In order to enlarge the knowledge about effects of SFS dosage in the evolution of mortar durability and mechanical resistance, ACCIONA has fabricated standardised lab specimens of several mortar mixtures, using ordinary cement 42.5N of medium strength and varying the % of substitution of natural sand with SFS (0%, 10%, 20%, 35%, 50%). Results of the UCS values after 7 and 28 days are available that show reduced UCS values versus the control experiment for all dosages. However, there are no losses of mechanical resistance between 28 and 7 days observed in any of the mortars. Monitoring will be extended with UCS measurements after 90, 180 and 365 days to check mortar resistance in the long term.



Mortar constituents	SFS dosage				
	0%	10%	20%	35%	50%
cement CEM IV 42.5N (kg/m³)	350	350	350	350	350
water (kg/m³)	205	205	211	214	227
natural sand (kg/m³)	1491	1341.9	1193	969	680
reclaimed CHEM SFS (kg/m³)	0	149.1	298	522	675
X-Seed aditive (%)	0	1	2	4	5

Figure 4. Monitoring study of compression resistance of mortars with varying SFS dosage

Evaluation of reclaimed SFS as moulding sand

A first series of bending specimens has been prepared, using a fixed catalyst content (4%) and three levels of resins (0.85%, 1.01% and 1.15%) in the mixtures, keeping the ratio between the two binder components at 55:45. The types of sand (TR, MR, ECO-SANDFILL) were mechanically mixed in an automatic sand mixer according to their shares in each designed formulation (Table 1) and then the catalyst and resin binders were added and mixed with the sand in the adequate proportions. Additionally, a mixture of new sand containing low addition of primary regenerated sand ('new/MR') has been tested for comparison purposes.

Transverse strength over time, strip time and bench life have been measured on that first series of moulding sand mixtures specimens. The values of bending resistance after 24 hours of moulding sand specimens manufactured with 100% ECO-SANDFILL reclaimed sand (S03) and specimens of 100% new/MR sand, both with 0.85% resins, are the same. However, strip time and bench life of the S03 specimen are significantly higher. Bench life to strip ratio of that mixture is 0.70 (versus 0.73 ratio of 100% new/MR and 100%TR specimens). Taking as a reference the 100%TR formulation (S01), the increasing share of ECO-SANDFILL sand in moulding sand mixtures tends to cause increasing bench life and strip time values. However, reducing or raising the amount of hardener and catalyst can control curing speed and satisfy the foundry's requirement. The combined effect of increasing share of resins and higher dosage of reclaimed ECO-SANDFILL sand is proven by the evolution of bench life and strip time in TR + ECO-SANDFILL mixtures: strip time of S06 mixture is lower than S07 formulation, as resins content increases by 0.15%; (bench life to strip time ratio rises from 0.66 to 0.79).

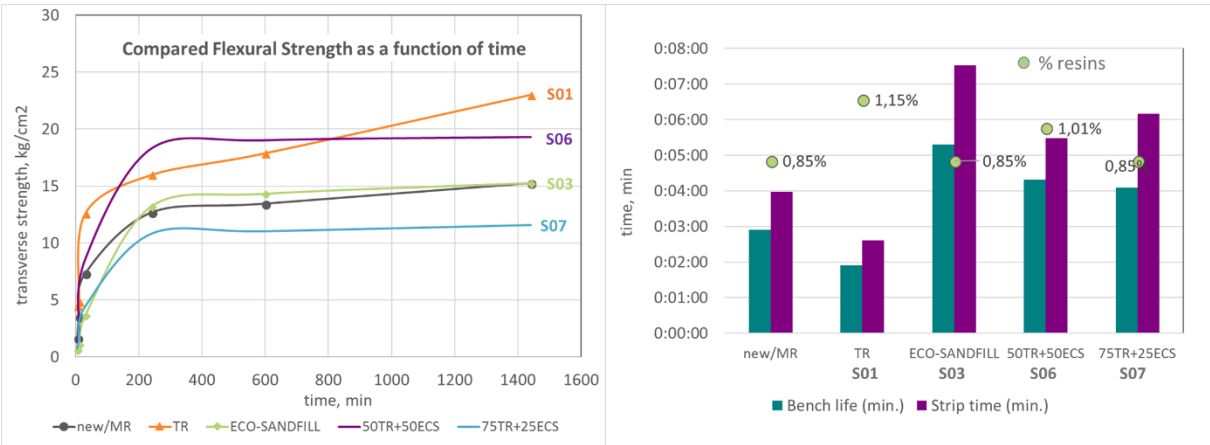


Figure 5. Results of bending tests, bench life and strip time for moulding sand formulations

CONCLUSIONS

Spent foundry sands are classified as non-hazardous waste due to their leaching behaviour and, being a waste, they have to be handled by an authorised waste manager, all of which restricts their valorisation possibilities. The LIFE ECO-SANDFILL experimental procedure has demonstrated that subjecting the waste sand to some conditioning to remove foreign materials and impurities expands its valorisation options. The mechanical attrition technology implemented in the project enables chemically bonded SFS (PEP SET) to reach the acceptance criteria for reusing foundry sand in different construction applications:

- The cleaning degree achieved helps reclaimed SFS comply with leachate limits for inert waste and makes possible to use it as granular filling material in geotechnical applications. The characteristics of that reclaimed foundry sand classified it as tolerable soil in the core and foundation of embankments (PG-3, Art.330), blended 80:20 with borrow material to enhance compactability.
- When used as 100% substitute for natural sand in CLSM applications, the compressive strength requirement of 1 MPa for trenches backfilling is satisfied.
- The dosage and durability studies of flowable mortars indicate that it could be employed as secondary aggregate in non-structural backfilling applications (specified UCS = 15 MPa) using sand substitution ratios ≤10%. That secures that UCS values drop less than 20% with regard to those of an equivalent mortar without SFS. Type of cement and additives in the mixtures strongly influence the mechanical resistance of the mortar and can help increase substitution ratio up to 50%. Apart from the observed loss in engineering properties, reclaimed CHEM SFS dosages over 50% require higher consumption of cement, water and additives, increasing mortar manufacturing costs.

Regarding reuse of chemically bonded SFS reclaimed in the LIFE ECO-SANDFILL prototype in the moulding shop of the steel foundry, the recovered sand obtained in the prototype does not meet the requirements for core making, as a replacement of new sand. Research is in progress to establish to what extent it can replace thermally regenerated sand as facing sand in moulds and the necessary adjustments of % of resins and catalyst in the formulations.

ACKNOWLEDGEMENT

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