AFTER LIFE COMMUNICATION PLAN

LIFE17 ENV/FI/000173

Green Foundry

1/7/2018-30/6/2022

Meehanite Technology Oy
AGH University of Science and Technology
Centre Technique des Industries de la Fonderie
Dipartimento d´Ingegneria, University of Perugia
Technology Industries of Finland
Karhula Foundry Ltd
AX-LVI consulting Ltd
Eurofins Viljavuuspalvelu Oy
Foundryteam Ltd
Fundiciones Araba SL
Fraunhofer IFAM

Green Foundry LIFE

AIM OF PROJECT

The main objective of the Green Foundry project was to decrease the environmental impact of the European foundry industry by introducing novel technologies for sand molding systems. The general idea was to demonstrate new inorganic binder systems in ferrous foundries.

The application of modern sand molding systems based on inorganic binders would have a significant positive environmental and economic impact leading to increased competitiveness of the industry. The Green Foundry project had following seven objectives to be reached:

1. Decrease hazardous air emissions from the casting process – the project demonstrated in small scale chamber tests the remarkable emission reductions of about 80-99% when changing the organic binders to inorganic ones.

2. Improve the indoor air quality for a safer work environment – organic binders emit hazardous casting fumes and fine particles like binder aerosols

3. Improve the use of natural resources – using inorganic binders would allow foundries to use the foundry sand more efficiently. Project demonstrated different methods for purification and re-use of surplus foundry sand.

4. Provide encouraging examples for the industry on EU level by implementing the new inorganic sand molding systems in three ferrous pilot foundries in Finland, Italy and Estonia.

5. Produce the necessary practical tools for the industry with required information on the implementation of inorganic sand molding systems in ferrous foundries.

6. Disseminate the results on EU level for immediate implementation of the best practices.

7. Provide Smitheries and Foundries BREF with BAT publication including technical solutions of inorganic binder systems in ferrous foundries.

PROJECT RESULTS

Results of demonstrating inorganic binder systems in three ferrous foundries showed that wide scale implementation of inorganic binders requires:

- Vast knowledge about different inorganic binder systems and their proper implementation into current or new production lines.
- Individual implementation plan for each foundry including suitable inorganic binder systems for the foundry's production lines and products, and technical and economic information about possibly needed investments.
- In most cases investments for moulding, core-making and sand regeneration methods are needed and broad preliminary testing should be carefully carried out before commitment.
- Due to traditional nature of the branch, there should be successful example cases of replacing the organic binder systems by inorganic binders, so that new ferrous foundries would dare to start the change and introduction of inorganic binder systems in full production scale.
- Suitable sand reclamation system should be tested for inorganic binder system waste sand. In case foundries take inorganic binders in use in part of the production or for some products it is necessary to solve the sand reclamation system because different waste sands must not be mixed.

Emission measurements of moulding sands with organic and inorganic binders on laboratory scale:

- Moulding sand with organic binders generated 2 to 3 times more gas volume than other inorganic binder mouding sands.
- Moulding sands with organic binder (phenolic Alphaset and furan) showed significantly higher emission of compounds from the PAHs and BTEX group than moulding sand with inorganic binders; the difference was even 10 times.
- Green sand (bentonite) showed relatively low emission of compounds from the PAHs and BTEX groups because in the bentonite mixture the coal dust was partly replaced by more environmentally friendly components.
- Moulding sands with inorganic binders are characterised by lower harmfulness for the environment and employees than moulding sands with organic binders.
- Small scale chamber tests at URV and Karhula foundries were made with moulding sands with two inorganic binders and organic phenolic Alphaset binder. Results demonstrated remarkable emission reductions for CO, SO_2, VOC, BTEX and phenol of app. 90-99%.

Recycling options and sand purification of inorganic and organic surplus foundry sands and dusts:

<u>Composting method demonstrations</u>

- Composting tests were performed on industrial scale in 2019-2022 in Finland and Spain.
- Harmful organic substances (DOC, PAH, BTEX, phenol) and fluoride can be degraded by 50-90% in the composting process.
- Produce clean soil material for new reuse applications as landscaping and green construction purposes.
- Reduce the total amount of waste sand to be landfilled.
- Composting companies can save natural resources by replacing the natural sand by surplus foundry sand in the compost material and clean it during the composting process.

Thermal reclamation demonstrations

- Reclamation of foundry sands is a combination of techniques used to recycle the used sand back into the moulding process.
- Thermal reclamation tests were carried out at Finn Recycling's existing thermal reclamation process plant in Finland where ester cured phenolic resin no-bake sands (APNB) is commercially treated. For this project also inorganic binder waste sands were tested.
- Results: Efficient method for organic phenolic waste sands, promising results for furan waste sands, small improvements needed for treating inorganic binder waste sands. For cleaning the green sand, the thermal reclamation is not enough alone.

Washing method tests

- Laboratory tests demonstrated that the hazardous compounds (e.g. metals and phenol, DOC, TOC, BTEX) were rinsed away from the waste sand samples (green sand and inorganic binder waste sand) and broken down by processes involving distilled water and hydrochloric acid.
- More tests and industrial scale tests are needed in order to evaluate the suitability of this method also the environmental impacts.

Hydromechanical, ultrasonic, mechanical treatment tests

- Treatment trials were carried out on laboratory scale with different inorganic binder system waste sands. Mechanical, hydromechanical and ultrasonic methods were tested.
- Results: hydromechanical and ultrasonic technologies are particularly effective in allowing treated sand to be reused in foundry, geo-construction or road engineering.

- Results confirm that the hydromechanical treatment of inorganic sand waste is particularly effective for the reuse of treated sand in moulding or core making. Results with ultrasonic were similar.
- Nevertheless, hydromechanical and ultrasonic treatment processes need to be tested on an industrial scale to verify whether these emerging technologies would be viable, compared to solutions using conventional technologies (mechanical, thermal, thermomechanical).


Hydromechanical Ultrasonic treatment

BAT report for the BREF revision

- The Best Available Technology Reference Document (BREF) for the smitheries and foundries industries is currently in preparation through the established Seville process.
- Green Foundry LIFE project has prepared BAT report, which will be delivered to BREF revision working group for analysing. Based on the results of the project, the concrete proposals for uptake of the respective technologies and processes in the updated version of as either Best Available Technology (BAT) or Emerging Technology (ET) candidates:

Designation of technology	**Status**
Use of inorganic binders for moulds in iron and steel casting	BAT
Use of inorganic binders for cores in iron and steel casting	BAT
Thermal reclamation of foundry sand	BAT
Composting of waste foundry sand	BAT
Washing of foundry sand	ET
Ultrasonic treatment of foundry sand	ET
Hydromechanical treatment of foundry sand	ET

Dissemination activities after the end of the LIFE project

Events

1) BDG (German Foundry Industry Association) Technical Committee Light alloys – sand and gravity die casting (Fachausschuss Sand- und Kokillenguss), autumn 2022. Project presentation to foundry industry representatives and academic professionals. Presented by Fraunhofer IFAM. National event in Germany.
2) FEAF (Spanish Foundry Industry Association) Technical Committee, September 2022. Project presentation to Spanish foundry industry and academic professionals. Presented by Tecnalia Research&Innovation/Araba. National event in Spain.
3) Valun käytön seminraari in Tampere on 3-4.11.2022. Project presentation by Technology Industries of Finland to foundry engineers, casting users and suppliers. National event in Finland.
4) 36 Congresso Tecnico di fonderie organized by Assofond in November 2022 in Italy. Oral presentation by UNIPG to foundry industry, relevant companies and authorities. National even in Italy.
5) ISM 2022 The International Conference on Industry 4.0 and Smart manufacturing on 2-4.11.2022. Presentation by UNIPG to academic experts in modelling and simulation in Foundry industry. International event.
6) The 74th World Foundry Congress 2022 16~20 October 2022, Bexco, Busan, Republic of Korea. Presentation by Prof Rafal Danko, AGH, Poland. International event.

Publications

1) Project article in the Valimoviesti magazine in 2022 by Technology Industries of Finland/Meehanite. National magazine.
2) Results of Green Foundry project at AX magazine to be published in 2023. Magazine with the distribution of about 1,500 pieces.
3) Reduction of emissions in ferrous foundries by using inorganic binder systems. Presentation and article in The 74th World Foundry Congress 2022, Republic of Korea. Published by China foundry.
4) Article on the project in Forge Fonderie Magazine (2nd semester 2022) by CTIF

Other activities

Meehanite will *maintain the project website* where relevant news and events are updated also after the end of project. Project leaflets, Layman´s report and project deliverables will be placed on website.

Project leaflets (paper and electric) *will be distributed via seminars, conferences and exhibitions* where the project partners participate after the end of the project.

Meehanite Technology and other partners will *disseminate the results actively* after the end of the project and keep presentations in national and international foundry seminars, conferences and exhibitions.

Project member D.Sc.Tech Juhani Orkas is a member of Smitheries&Foundries BREF Technical Working Group (TWG) and he has worked as a link between the project and the TWG. The produced BAT publication was provided for the use of the ongoing BREF work. *Discussions and feedback requests will continue also after the end of the project and partners are committed to provide all the data and information related to these proposed BAT/ET technologies.*

New *Green Casting LIFE continuous application was prepared* in 2021 in cooperation with some current project partners and with new partners and including 6 partner foundries in Europe in order to demonstrate the feasibility of the inorganic binder systems in full scale production and to solve the technical challenges that came out during the Green Foundry LIFE project e.g. inorganic binder system waste sand reclamation and cleaning methods. Partners are committed to continue activities to overcome these issues after the end of the project e.g. in other projects, or workshops that came out duding the project Webinar in April 2022 in cooperation with foundries.

Meehanite will promote the introduction of the inorganic binders in European ferrous foundries after the end of the project. Different expertise and test packages for foundries have been created in the Business plan. *The database of the potential ferrous foundries, which are willing and able to implement inorganic binders, has been created and it will be utilised after the end of the project.* Vast contact network during previous and current LIFE projects and at the preparation of the new proposed Green Casting LIFE project has been created. *The potential foundries will be personally contacted,* and after face-to-face interviews the individual implementation plan will be offered to the foundry. The implementation plan includes all the necessary know how which is needed to apply inorganic binders in some or all production lines of the foundry, for example the most suitable inorganic binders and their recommended recipes, sand reclamation methods, potential needs of equipment investments and reuse application of the surplus waste sand. Meehanite can also take part in the realization of the implementation plan, to the extend agreed.

Meehanite will continue activities to *foster the composting method* as a one cost-effective method for *cleaning method for surplus foundry sands* in cooperation with foundries in Finland and EU.

Networking activities with other projects

Close cooperation has been carried out with the *Foundrytile (LIFE14 ENVES/252)* partner AFV (Asociacion de Fundidores del Pais Vasco y Navarra) in Spain. New LIFE project proposal has been prepared in 2021 where one major theme is the recycling treatments of the inorganic binder system waste sands.

LIFE ECO-SANDFILL (LIFE15 ENV/ES/612) project demonstrated technical economic and environmental feasibility of reclaimed spent foundry sand through innovative mechanical treatment methods. Azterlan and Meehanite have made close

cooperation in preparing the follow up LIFE application for clarifying and testing suitable recycling treatment methods for inorganic binder system waste sands. AVF, Azterlan and Meehanite are involved in the new LIFE application where one important topic is the recycling and reusing of inorganic binder system waste sands.

Cooperation has been made with Peak International Products (Germany) during the Green Foundry LIFE project within the test casts carried out in three pilot foundries and the emission measurements. PEAK has provided raw materials for project purposes. Cooperation started based on the results from the *Eureka Project E!4542 Cleanbinders Europe* in 2009-2014 and *Gietech-GO project* in 2016-2019.

Funding plan

The costs of the planned activities after the project end will be covered by each partner's own resources.

Project website

www.greenfoundry-life.com

Project consortium

Coordinator:

Meehanite Technology Ltd, Finland
Sara Tapola, Project manager
sara.tapola@ains.fi
+358 40 5518761

Partners:

AGH University of Science and Technology, Poland

Fundiciones Araba SL, Spain

AX-LVI Consulting Ltd, Finland

Centre Technique des Industries de la Fonderie, France

Dipartimento d´Ingegneria, University of Perugia, Italy

Eurofins Viljavuuspalvelu Oy, Finland

Association of Finnish Foundry Industry, Finland

Foundryteam Ltd, Finland

Fraunhofer Institute for Manufacturing Technology and Advanced Materials, IFAM, Germany

Karhula Foundry Ltd, Finland