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## **Action B5 Replication and transfer of the project results**

### **DeB5.3A Business plan**

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# 1. OPERATIONAL ENVIRONMENT

The European ferrous foundry industry is the third largest in the world for ferrous casting (CAEF, 2020), after China and India, and are responsible for 15% of the global production. Iron and steel industries belongs to the Energy intensive industries (EIIs) groups which are considered to be highly energy intensive. In 2020, the European ferrous foundry sector was composed by 1652 ferrous foundries which produced 9,1 million tons of casting (CAEF, 2020).

The ferrous foundry industrial sector is central for Europe economy and production, it covers many crucial and needed activities such as automotive (>50% of the market share), railway systems, mechanical engineering, shipyards, wind turbines etc.

With the will to enhance the strength of the industrial sector, be more competitive and less dependent of third countries, supporting changes in this traditional foundry sector towards greener and more sustainable production processes is a core issue and a big challenge. Nowadays the majority of European foundries use green sand system for moulding with chemical cores. Only 1% of the foundries use inorganic system for mould and core manufacturing in Europe (Hüttenes Albertus, 2018) and most of those foundries correspond to light metals, mainly aluminium.

## 1.1 NEEDS OF CUSTOMERS

Potential customers, ferrous foundry branch, is among the most polluting industries. Majority of the ferrous castings are produced by using sand moulds. Sand moulds are currently hardened by using organic binder systems, by green sand (bentonite) binder system or by furanic or phenolic resin binder systems. During casting process, these binder systems undergo thermal decomposition when exposed to the very high temperatures. During casting, the temperature is typically in iron and steel casting between 1.400°C and 1.550°C, where pyrolysis or an incomplete oxidation of the binders occurs forming hazardous (GHGs, NO<sub>x</sub>, Fine Dust), carcinogenic (Polycyclic Aromatic hydrocarbons PAH) and mutagenic compounds (Benzene, Toluene, Ethyl Benzene and Xylene BTEX) which can cause even cancer. These compounds form because of the incomplete oxidation during casting. Emissions produced during casting are the key environmental concern for the sector, causing pollution around the foundries and impairing the indoor air quality. Moreover, waste foundry sand includes many harmful impurities when organic binder systems are applied.

There are many factors influencing the need of ferrous foundry branch to decrease the polluting in future:

- EU has set targets in “Green Deal” to decrease the harmful emissions and to improve the indoor air quality in major industries
- End customers such as automotive industry are increasingly environmentally conscious and will favour in future the suppliers which have cleaner production processes
- Waste sand disposal is problematic, and sand reuse is impossible without costly treatments
- It is more and more difficult to get employees to unhealthy workplaces in EU

- Best Available Technology (BAT) Reference Document (BREF) is currently being prepared for the smitheries and foundries industry according to the Sevilla process: The requirements for the limit values for impurities will decrease

## 1.2 THE SOLUTION

The application of inorganic binder systems instead of current organic binder systems provides a solution to remarkably reduce harmful emissions and improve indoor air quality in ferrous foundries. Waste sand problem will be also improved because inorganic binder system surplus foundry sand will contain less harmful substances such as DOC, BTEX and phenols than organic binder system surplus foundry sand, which often must therefore be landfilled. Inorganic binder system waste sand can be reused in e.g. geo construction purposes, and landfilling can be avoided.

Meehanite Technology has during the project gathered extensive know-how on the applying of inorganic binders in ferrous foundries and has good contacts with the best experts in the field: inorganic binder producers, research institutes, universities and ferrous foundries which have piloted inorganic binders. Meehanite Technology can provide foundries, which are interested to change to inorganic binders, a full package of knowledge including:

- Recommendations for suitable inorganic binder types for the foundry
- Recommend recipes of binders and hardeners
- Recommendations for the process changes and devices needed to change the binding system
- Solutions for foundry sand reclamation methods and possible waste sand reuse application
- Solutions for other means to improve indoor air quality, eg. by designing local ventilation
- Investments plans, including cost and pay-back time calculations

Meehanite provides solution to the waste foundry sand problem for ferrous foundries, which use exclusively or partly organic binder systems. The method, patented by Meehanite, is based on composting. Due to organic binders, waste foundry sands include harmful organic compounds like phenols, PAHs, BTEX, and cresols, which often prevent re-use. During composting, microbes degrade the harmful organic substances into H<sub>2</sub>O and CO<sub>2</sub>, which reduces the contents of harmful organic substances to the levels, which allow the use of compost material eg. in green construction. The method has been successfully applied to phenolic, furanic and bentonite waste sands. Composting can be applied also for inorganic binder waste sands even if they do not contain harmful organic compounds. These waste sands can replace virgin natural sands which must be added to compost material which is used in green construction. Landfilling can be avoided this way and the foundries can also avoid extra fees.

## 1.3 MARKETS AND CUSTOMER TARGET GROUPS

The European ferrous foundry industry is the third largest in the world, after China and India, and it is responsible for 15% of the global production.

In 2020, the European ferrous foundry sector was composed by 1652 ferrous foundries which

produced 9,1 million tons of casting (CAEF, 2020).

The main targeted customers are ferrous foundries in the project partner countries Finland, Germany, Poland, France, Spain and Italy. The ferrous foundries in these countries account 68% of the total European production of iron and steel castings. Secondary targeted customers are ferrous foundries in other EU countries such as Sweden, Denmark, Netherlands and Czech Republic.

## 1.4 COMPETITION AND COMPETITIVE ADVANTAGES

Most of the harmful emissions in the ferrous foundries using sand moulds are caused by the currently used organic binder systems, ie. phenolic, furanic and bentonite binder systems. These represent more ca. 99% of the total production volume in EU. We are not aware of any other method which could reduce emissions as much as changing from organic binder systems to inorganic binder systems.

Competition advantage has been achieved during the project by gathering vast information about the usage of inorganic binders in ferrous foundries, from the close co-operation with the inorganic binder suppliers and from direct production-scale experiences, which show the proved, measured benefits of inorganic binder systems.

Contacts with potential customers has been created already during the project by extensive dissemination program including for example public project webinar for nearly 300 stakeholders, mainly ferrous foundries, national seminars, fairs and other events in foundry branch.

Compared to potential competitors, Meehanite has very extensive co-operation network due to previous, ongoing and applied EU projects (eg. LIFE21-ENV-FI-GREEN CASTING LIFE). Network consists of European ferrous foundries, international and national foundry associations, inorganic binder producers, research institutes and universities conducting research in the foundry sector.

## 2. PRODUCTS AND SERVICES

### 2.1 PRODUCTS/SERVICES

The main product will be a service package to introduce inorganic binder system in iron and steel foundries. The service package will offer iron and steel foundries a process know-how of inorganic binders, information about the environmental and indoor air quality improvements, used sand regeneration methods and waste sand reuse and recycling technologies and relevant patent. The package will include all the necessary information for the customer foundry to start to implement inorganic binders in their production lines or in some part of their production or products. The service package will include foundry process know-how, technical solutions, equipment investments with cost calculations and technical solutions for waste problems

Meehanite personnel will also offer consultation in negotiating with relevant authorities and Meehanite will also apply the environmental permits in cooperation with the customers. The Financial analysis will be supported by Return on Investment (ROI) performance measure to evaluate the efficiency of an investment and economic impact of applying inorganic binders in ferrous foundries.

Composting service package includes preliminary study and tests, the recommendations for compost recipes, making the environmental permits, starting composting, taking the analysis samples and monitoring of the process. For this package annual fee is typically applied.

Meehanite personnel are experts in foundry production, implementation of inorganic binders in ferrous foundries, cost calculations, negotiations with authorities and making the environmental permits and providing know how to solve the waste problems. The solutions for local and total ventilation can also be offered. The required service package will be customized for each foundry, based on their needs and wishes.

### 3. BUSINESS MODEL

The solution will be commercialized under a business-to-business (B2B) business model, as the product will be sold to potential ferrous foundries directly. Many of the potential customers are already known at the end of the project because they have been dealt with during the extensive dissemination program.

#### 3.1 INTERVIEW

The potential customers will be approached directly by email and phone call. When the customer expresses interest, a face-to-face interview will be arranged with the key personnel. The interview will include:

- Existing production processes and products
- Interest and experiences with inorganic binders
- Targets and technical requirements for cores and moulds
- Which product lines are planned to be changed to inorganic binders
- Possible needs for new sand reclamation methods and equipment
- Needs for waste sand treatments eg. composting
- Possible need for ventilation

#### 3.2 IMPLEMENTATION PLAN

If the customer wants to proceed, an offer for preparing an implementation plan will be made. This plan will be specific for each foundry and will include eg. the following information:

- Type of inorganic binder selected for core and mould making. Dosages and methodology for the mixing in no bake, cold box and hot box systems.

- Process changes in the relevant areas (from de storage of the raw material, mould/core shop, pouring, solidification, shake out and reclamation unit). At the implementation first steps, in some cases with a by-pass, the current equipment (ie. shake out table) can be used.
- Investments needed in the decided production lines (from de storage of the raw material, mould/core shop, pouring, solidification, shake out and reclamation unit). Some examples include new silos for virgin sand and reclaimed inorganic sand storage, sand mixer for the inorganic lines, new core shooters in cold box and hot box, handling machines, storage areas for moulds and cores including possible heaters for controlling ambient temperature and humidity and the sand reusing circuit (pneumatic transport lines or conveyor belts in manual moulding, vibratory shakeout machines and sand reclamation units)
- The figures for the full inorganic implementation,
- Cost estimations of the investments
- Composting sites and methods
- The design of changes for ventilation

The price of the implementation plan depends on the extent of the use of inorganic binders in the production, the volume of the required investments and other involved issues eg. possible composting of waste sand and changes to ventilation. Rough estimation of implementation plan is 5000...20000 €.

### 3.3 REALIZATION OF THE IMPLEMENTATION PLAN

Meehanite will help in the realization of the implementation plan in the extent that the customer decides. The implementation of the customized plan which was made according to needs and wishes of the customers can include eg. the following steps:

- The pretests with the most feasible inorganic binders in the foundry or by a sup-supplier
- The investments of the equipment for moulding and other necessary accessories
- The investment of the equipment for the chosen sand regeneration method
- The investment of the ventilation equipment
- The testing and commissioning of the invested equipment
- The implementation of the composting site, including commissioning, testing and sampling
- The consultation with the authorities and the preparation of the environmental permit

applications

### 3.4 PRICING MODELS FOR THE REALIZATION OF THE IMPLEMENTATION PLAN

The cost is dependent on the role of Meehanite in the mentioned steps. Meehanite can act as a consultant or take full responsibility in some agreed phases such as pretests with the inorganic binders and in implementation of composting site.

Different pricing models will be applied, based on the negotiation with the customer:

-hourly rates, typically for the consultation of the development of the different process phases (eg. options for inorganic binders and equipment needed, preliminary study of possible sand regeneration methods, options for waste sand treatments), negotiations with the authorities and training

-fixed price for a certain package, such as performing preliminary tests with inorganic binders including reporting of the results, building a composting field, preparing and applying environmental permits for demonstrations, design of local and/or general ventilation, investment cost calculations

-annual fee, for example for the full handling of the composting field, including monitoring, sampling and analysis

## 4. BUSINESS TARGETS

### 4.1. KEY SUCCESS FACTORS

Key success factors are the extensive know-how gained during the EU projects coordinated by Meehanite during the previous decade, the extensive contact network in foundry branch created during these projects and the expertise of the personnel which have worked with technical and environmental issues of the foundry industry for decades.

The local experts which have been involved in the project or got to know during the project will be hires as consults, when the workload increases.

### 4.2. STRATEGIC OBJECTIVES

The ambitious goals are based on the assumption that the new Green Casting LIFE project proposal will receive funding. This project will increase both the level of expertise in all aspects related to the implementation of inorganic binders and the network of contacts. During the project, the introduction of inorganic binders in full production scale will be carried out in six flagship foundries in four EU countries and pilot testing in 15 ... 25 other ferrous foundries. In total 20...30 foundries will be involved in practical piloting. In addition, up to 200 ferrous foundries will be contacted and minimum 100 foundries will be interviewed in 8...10 EU countries. The project will generate successful examples of the applications of inorganic binders in full production, which will decrease the threshold of starting to use inorganic binders. These success stories will remarkably help to increase the planned business.

The strategy is to start the business with EU foundries which we know and have contacted already. The interviewed foundries in Green Casting LIFE project will create the next group of potential customers. Thereafter we will widen the market to other European countries, and also outside Europe, to North-America and Asia.

The strategic objectives for the first five years:

#### **Year 2023:**

#### **Domestic and EU:**

- Preliminary contacts and interviews in 100 foundries



- Consulting in 15 foundries
- Feasibility and implementation plan for 6 foundries

Export countries outside EU:

- Preliminary contacts and interviews in 30 foundries
- Consulting in 7 foundries
- Preparing feasibility and implementation plan for 6 foundries

**Year 2024:**

Domestic and EU:

- Preliminary contacts and interviews in new 100 foundries
- Consulting in 30 foundries
- Preparing feasibility and implementation plan for 25 foundries
- Realization processes of the feasibility and implementation plan in 12 foundries

Export countries outside EU:

- Preliminary contacts and interviews in new 50 foundries
- Consulting in 15 foundries
- Preparing feasibility and implementation plans for 10 foundries
- Realization processes of the feasibility and implementation plans in 3 foundries

**Year 2025:**

Domestic and EU:

- Preliminary contacts and interviews in new 150 foundries
- Consulting in 50 foundries
- Preparing feasibility and implementation plan for 30 foundries
- Realization processes of the feasibility and implementation plan in 12 foundries

Export countries outside EU:

- Preliminary contacts and interviews in new 75 foundries
- Consulting in 20 foundries
- Preparing feasibility and implementation plans for 10 foundries
- Realization processes of the feasibility and implementation plans in 3 foundries

**Year 2026:**

Domestic and EU:

- Preliminary contacts and interviews in new 200 foundries
- Consulting in 70 foundries
- Preparing feasibility and implementation plan for 50 foundries
- Realization processes of the feasibility and implementation plan in 18 foundries

Export countries outside EU:

- Preliminary contacts and interviews in new 100 foundries
- Consulting in 30 foundries

- Preparing feasibility and implementation plans for 15 foundries
- Realization processes of the feasibility and implementation plans in 5 foundries

### **Year 2027:**

#### Domestic and EU:

- Preliminary contacts and interviews in new 200 foundries
- Consulting in 80 foundries
- Preparing feasibility and implementation plan for 75 foundries
- Realization processes of the feasibility and implementation plan in 26 foundries

#### Export countries outside EU:

- Preliminary contacts and interviews in new 100 foundries
- Consulting in 35 foundries
- Preparing feasibility and implementation plans for 15 foundries
- Realization processes of the feasibility and implementation plans in 5 foundries

In five years we will have contacts in Europe with ca. 750 ferrous foundries, which represents 46% of the total number of ferrous foundries in Europe 2020 (acc. to CAEF). The target is that after year 2027 over 60 ferrous foundries have ordered and realized the implementation plans and started to apply inorganic binder systems in every-day practice.

Outside Europe, the target is to contact over 350 ferrous foundries, and 16 of them have started to apply inorganic binders in every-day practice.

## **4.3. FINANCIAL TARGETS AND BUDGET**

The targets for the sales:

- 2023: EU 900 k€ + export outside EU 360 k€ = 1260 k€,
- 2024: EU 1 800 k€ + export 720 k€ + licence and provision sales 150 k€ = 2 670 k€
- 2025: EU 2520 k€ + export 720 k€ + licence and provision sales 300 k€ = 3540 k€
- 2026: EU 4500 k€ + export 900 k€ + licence and provision sales 700 k€ = 6100 k€
- 2027: EU 5850 k€ + export 900 k€ + licence and provision sales 1300 k€ = 8050 k€

The budget and profit/loss calculations are shown in the table in annex 1.

The costs of the personnel are based on the following estimations:

Consult/engineer:

- Total annual salary costs: 87 000 €
- 100 travel days per year, total cost: 35 000 €

Office worker:

- Total annual salary costs: 58 800 €

The revenues from the consulting are based on the following estimations:

- Consulting fee per day: 1 200 €
- 150 billing days per year pre consult, total annual revenues per consult: 180 000 €

Profit/loss calculations show the following trend:

Year	Operating margin	Profit before extraordinary items and tax	Profit after 24% tax
2023	9,2 %	3,7 %	2,8 %
2024	13,2 %	7,6 %	5,8 %
2025	14,5 %	8,9 %	6,7 %
2026	29,3 %	25,2 %	19,2 %
2027	32,0 %	28,0 %	21,3 %

#### 4.4. FUNDING PLAN

The funding is planned to be done by self-financing. The starting costs are low because most of the work is mainly consulting and no major investments are needed. The revenues will start to increase as soon as first consulting orders are signed and an increase in income will make it possible to increase the size of the workforce. The starting number of employees at Meehanite Technology is two, and in the fifth year four. The other workforce will be independent partner consults in several countries. At the beginning the number of these consults is six and additionally one office worker. After five years the number of partner consults will be 26 and additionally five office workers are needed.

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