



HARDCAST SOLUTIONS



Nano-improved materials
and suitable industrial
casting process for metal
parts with enhanced
strength and hardness
properties

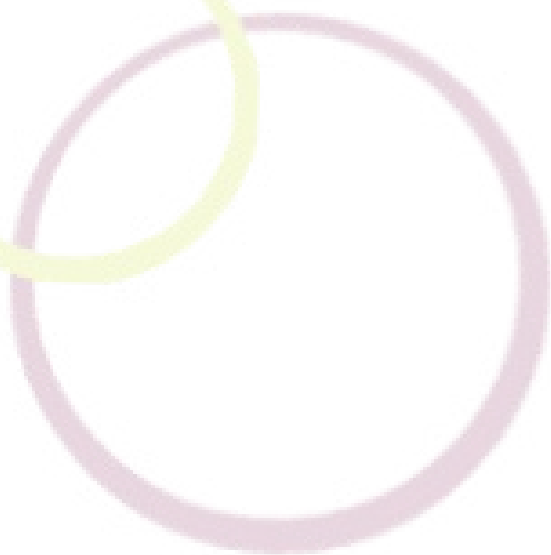
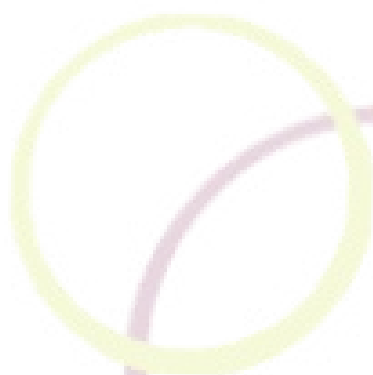
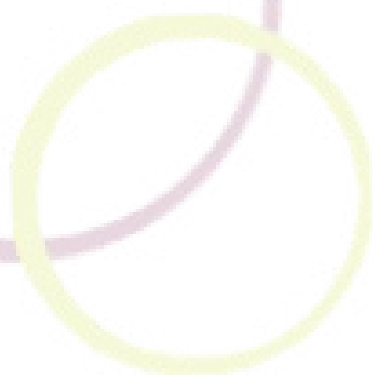
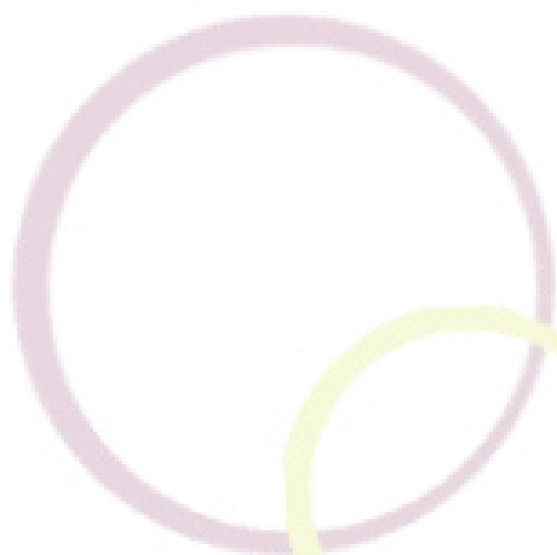


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 686165.

This brochure has been developed in the framework of IZADI-NANO₂INDUSTRY project (H2020, G.A. no.686165). It is aimed at presenting the main results achieved by HARDCAST PILOT partners, whose activities have been focused on the development of innovative materials and processes to produce metallic components of hydraulic motors with increased strength and hardness properties.



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Nanoreinforcements for improved metal castings



OUR ACHIEVEMENTS

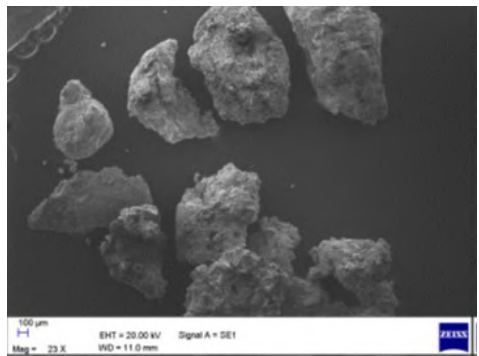
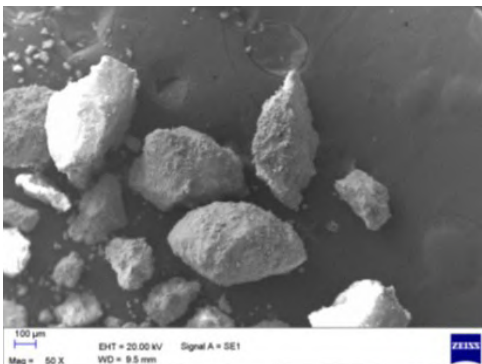
Masterpellets containing large amounts of nano-reinforcements ready to be added and able to improve the base cast material in terms of wear resistance, mechanical strength or damping properties.

WHAT WE OFFER

Formulation and delivery of tailor-made:

Technical consultancy services for the definition of nanomaterial design, size, compositions, morphology and application according to the customer requirements

Large scale production of masterpellets



Advantages of IZADI-NANO₂INDUSTRY Masterpellets



Easier dispersion and wettability of the nano-reinforcement in the metallic matrix

30% increased tensile properties in comparison with standard ductile cast iron material

The material allows lightweight concepts: possible changes in the design of current components to reduce thickness and weight

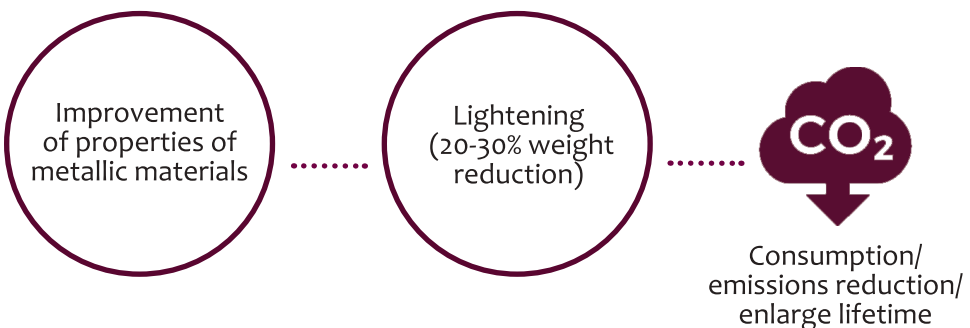
Possibility of substituting current steel or ADI components

Suitability for a large number of applications

Same way of use as any other products or raw materials, without safety or handling concerns

Avoidance of most environmental issues related to the incorporation of nanomaterials

The incorporation of special nanoparticles in the cast iron avoids the traditional coating or deposition after the casting process and the use of lubricants during parts operation, reducing in this way the production phases and related costs, and improving the production environmental impact as well

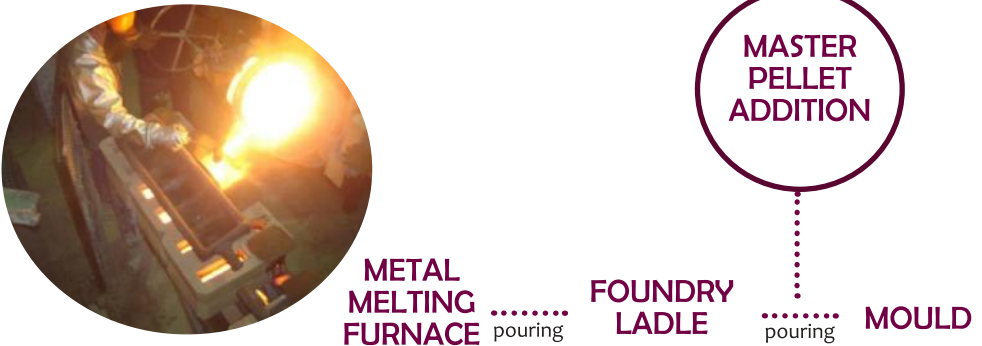


New gravity castings process for nanoreinforced metal parts

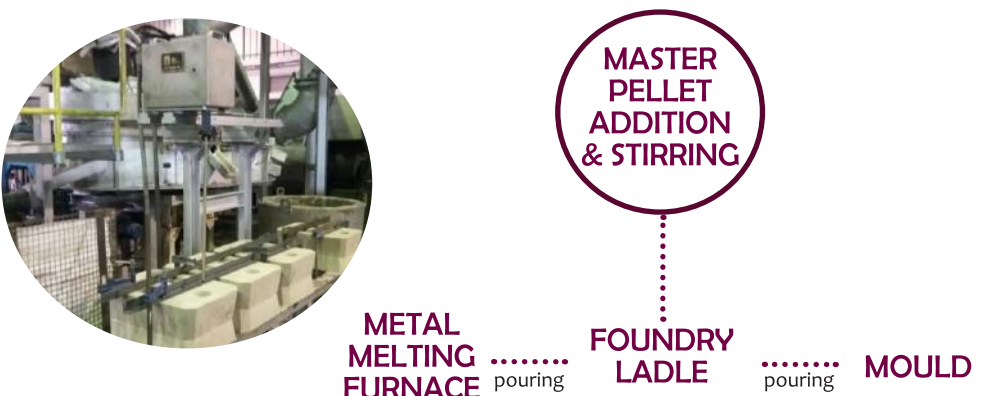
OUR ACHIEVEMENTS

Completely safe process, similar to the ones currently used in the foundries where nanometer size powders are not handled.

For **small percentages** of nanoreinforcements used, no stirring devices are needed.



For **higher percentages** of nanoreinforcements, stirring devices would be necessary to allow the complete melting with the rest of the liquid metal. In this case, the solution is to add the masterpellet and stir the melt.



Advantages of IZADI-NANO2INDUSTRY casting process for nanoreinforced metal parts



Robust casting process allowing homogeneous structure and properties of the nanoreinforced components

Industrial machinery with increased mechanical efficiency and reduced pressure losses

Suitability to most common stirring systems

Comparison of main existing systems for the incorporation of nanoreinforcements into the melt alloys

	PROS	CONS
MECHANICAL STIR CASTING	Simple and cost-effective	• Air entrapped • Only for low melting temperatures (Aluminium)
ELECTROMAGNETIC STIR CASTING	• Suitable for high production • Configurable flows are possible	Inert atmosphere needed
ULTRASONIC ASSISTED CASTING	Special interest when the Nano reinforcements trends to form agglomerated forms	• Mainly focused on breaking agglomerations • Limited area of action • Only for low melting temperatures (Aluminium)
ULTRASONIC PROBE ASSISTED STIR CASTING	Improves the uniformity in dispersion when agglomeration can occur	• Two equipment necessary • Only for low melting temperatures (Aluminium)

Compatibility of HARDCAST Technology with the main existing systems for the incorporation

	SMALL % OF REINFORCEMENT	INITIAL INVESTMENT	HARDCAST SUITABLE
MECHANICAL STIR CASTING	✓	↑	✓ With modification
ELECTROMAGNETIC STIR CASTING	✓	↑ ↑	✓
ULTRASONIC CASTING	✓	↑ ↑	✓ With modification
ULTRASONIC STIR CASTING	✓	↑ ↑	✓ With modification
ZERO GRAVITY CASTING	✓	↑ ↑ ↑ ↑ ↑ ↑	✗
GAS PRESSURE INFILTRATION	✗	↑ ↑ ↑	✗
SQUEEZE CASTING	✗	↑ ↑ ↑ ↑	✗
SPRAY DEPOSITION	✓	↑ ↑ ↑	✗



**Casting &
Coating**

**Main app
Are**



Automotive



Energy



Naval

Application
Areas

Technical
Ceramics

Agriculture

Aeronautics

Construction

Early adopter: CONSTRUCTION AND AGRICULTURAL MACHINERY SECTOR

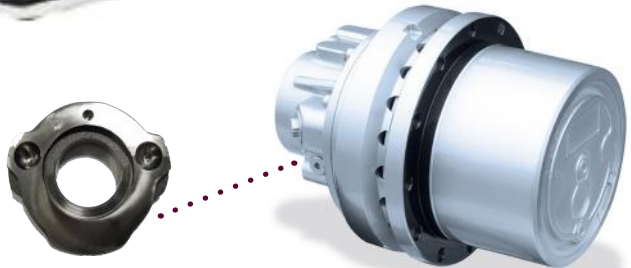
Need:

Improved
DURABILITY
(6000 h, i.e. 5000 h
+20% of target)
and Increased
EFFICIENCY



Selected Component:

Swash plate of
hydraulic motor



In a hydraulic motor, the swash plate translates the linear motion of the pistons into rotary motion of the cylinder block.

Dimension: $\Phi 118 \times \Phi 48 \times 38$ mm. | Current material: Ductile cast iron Gs700-2

Results Achieved: INCREASE OF THE MECHANICAL PROPERTIES OF THE COMPONENTS



Increased mechanical properties of the components (up to +30% in Tensile Strength and +4% in Elongation), that would entail the possibility of designing thinner components



No additional production costs due to the use of nanoparticles



Improved mechanical properties of components of the hydraulic motor

Comparison of the properties of ductile cast irons reinforced with nanoreinforcements and the corresponding non reinforced ductile cast iron

Material	0,2% Proof. stress. (MPa)	UTS (MPa)	Elongation (%)	Hardness HB (SD)
EN1563 (2000)	420	700	2.0	250-311
IZADI-800	+30% increase	+20% increase	6.0 (Threefold)	295 (1.26)
IZADI-900	+30% increase	+30% increase	6.0 (Threefold)	302 (2.16)

Better mechanical properties compared to reference material EN1563 (2000)

Good dispersion and wettability in the final melt

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Nanostructured Powders Producer

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IZADI-NANO2INDUSTRY (H2020, G.A. no.686165) aims at contributing to overcome the barriers that nano-materials are currently facing to get introduced in the market. During the project, technologies and strategies based on nano-reinforced materials, nanotextured surfaces and nanostructured-coatings have been implemented in three innovative PILOTS that are proposing new added-value products to OEMs and solutions to the European Automotive, Construction and Agricultural Machinery sectors.

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