



INSTITUTE
OF TECHNOLOGY OF METALS
of National academy of sciences
of Belarus

Art Casting of Nonferrous Metals



Production of original prizes,
souvenirs, bas-reliefs,
statues, memorial tablets
and other sculpture works
out of bronze and aluminum

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The Institute is engaged in:

Corrosion research:

1. Development of diagnosis system of the metal surface damage
2. Development of prognosis system of the steel surface damage by the Light Section Profiling System (LSP system) in high-speed production process
3. Development of prognosis system of the steel bulk property claim by the magnetic detection method in continuous production process
4. Diagnosis system of quality control and process control by digital image analysis
5. Universal magnetic thickness gage
6. Development of anti-corrosive active polymer film for steel packing



Coatings research:

- 1) Physical Vapor Deposition (PVD)
- 2) Plasma Chemical Vapor Deposition (CVD)
- 3) Ion Beam Deposition
- 4) Electron Beam Surface Hardening
- 5) Laser Beam Hardening
- 6) Magnetron Sputtering
- 7) Magnetic Impulse Hardening
- 8) Cladding
- 9) IMM (Induction Metallurgical Method) Surface Hardening
- 10) *Thermal Spray Coating Process*
- 11) *Flame Spray*
- 12) *Detonation Flame Spraying*
- 13) *Nontransferred Plasma Arc Spraying*
- 14) *Electric Arc Spraying*
- 15) *Activated arc spray-Hypersonic metallization*
- 16) *High-Frequency Pulse Hardening of Surfaces*
- 17) *Wire Arc Coatings*
- 18) *Metallization Of Ferrites and Creation Of Fixed Compositions Ferrite-metal*
- 19) *Equipment For Surface Metallization and Blazing Of Oxide Materials*

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Continuously-iterative casting by freezing-up

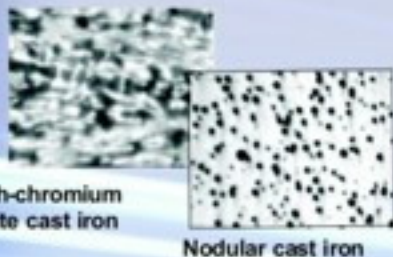


Liquid metal comes from the ladle through the feeder (1) and connecting sleeve (2) into the water-cooled mold (3). The formed round casting (5) is cyclically extracted upward by the movable section (4) of the mold.

The main features of this scheme are the following: the siphon feeding of metal to the mold, directional solidification, and the absence of a core.

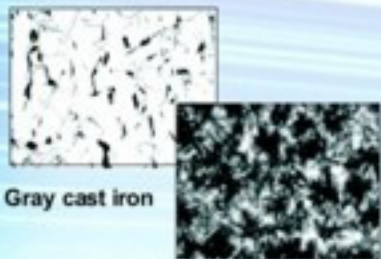
Advantages

The technology makes it possible to produce castings with the preset structure and physical & mechanical properties in a continuous-iterative mode at the expense of directional solidification and heat treatment combined in a united production process.



High-chromium white cast iron

Nodular cast iron



Gray cast iron



Application area

Cylinder sleeves, valve seats, piston and gasket rings for internal combustion engines, compressor, turbo-compressors, and so on.

Main characteristics

Billet dimensions:

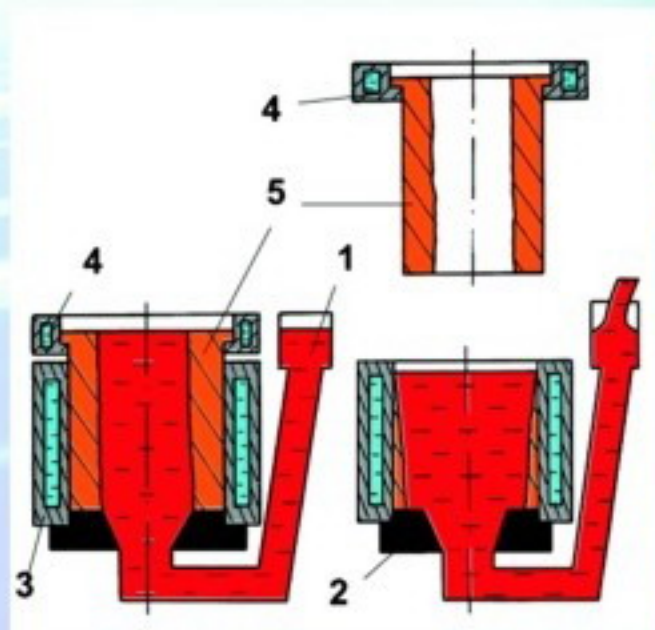
- outer diameter 50-185 mm
- wall thickness 10-15 mm
- height..... 150-300 mm

Output 100-240 castings/h

Ingot-to-product yield 90-95 %

Hardness of:

- gray cast iron 229...255 H Br
- high-duty cast iron with globular graphite 255...277 H Br



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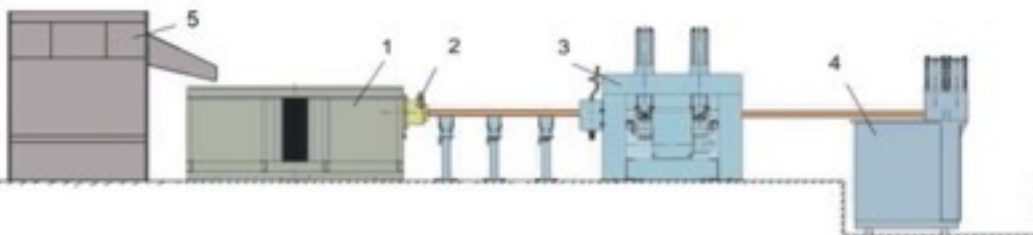
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Director of Institute of Technology of Metals
Dr (foundry), Professor E.I. Marukovich

The Institute designs, produces, delivers, performs installation and service of environmentally friendly resource-saving technologies and equipment for continuous casting of ferrous and non-ferrous metals; electroslag casting of billets, including bimetal; centrifugal casting of bimetals. Performs energy inspection of enterprises, mathematical simulation of casting processes, calculation of stresses of metalwork, digital image processing for improvement of quality and spatial resolution, certification of standard samples of metals and alloys with expired useful life, chemical analysis of metals and alloys, compacted powders, wire by the method of atomic emission spectroscopy, metallographic analysis.



- 1- mixer
- 2- crystallizer
- 3- withdrawal-roll set
- 4- automatic cutter
- 5- melting furnace

Continuous horizontal casting.

Material: bronze, cast iron

Shape: round, rectangular

Rod diameter: 20-300 mm

Section of rectangular rods: from 30x50 to 150x200mm

Single stream output:

-bronze 280-420 kg/h

-cast iron 300-700 kg/h

Power consumption:

-melting furnace 180 kW

-mixer 70 kW

Capacity:

--melting furnace 500 kg

-mixer 500 kg

Installed power of electric motor of the withdrawal-roll set: 5 kW

Electroslag casting:

Casting weight: up to 300 kg

Power consumption: 650 kW

Centrifugal casting:

External diameter ... 600 mm

Inner diameter ... more than 20 mm

Billet length up to 500 mm

Bronze layer thickness not less than 0.25 mm

Machining allowance 0.5-1.0 mm

Freezing-up casting:

Weight of semiautomatic casting plant

4.5 tons

Required work space 60 m²

Output 100 ... 150 castings/hour

Yield 90 ... 95%

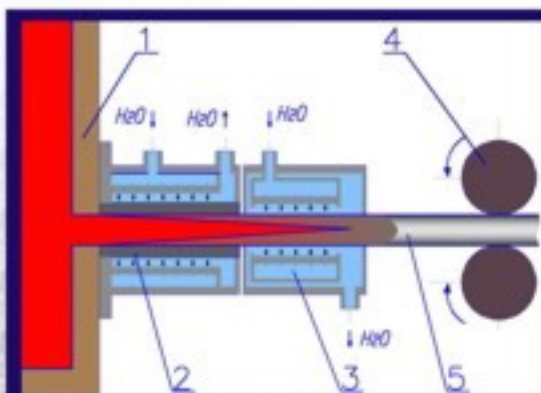


The Institute presents a jet crystallizer and a device with jet-submerged secondary cooling system of an ingot for continuous and continuously-iterative casting of alloys. The crystallizer allows increasing the productivity of casting 5 times and fining its structure 4...10 times as compared to casting into standard (slot) crystallizer.



High rate of crystallization allows obtaining ingots with high dispersion microstructure without application of environmentally unsafe and expensive modifiers. Is used for production of ingots with improved mechanical properties and recycling of secondary metals into billets for mechanical engineering industry.

Operation of jet crystallizer with jet-submerged secondary cooling system is based on homogeneous jet-submerged cooling of the crystallizer case and ingot throughout the height and perimeter. Homogeneity of cooling of the crystallizer case and the ingot improves operation life of the equipment and stability of the process and increases the quality of continuous-cast ingot.

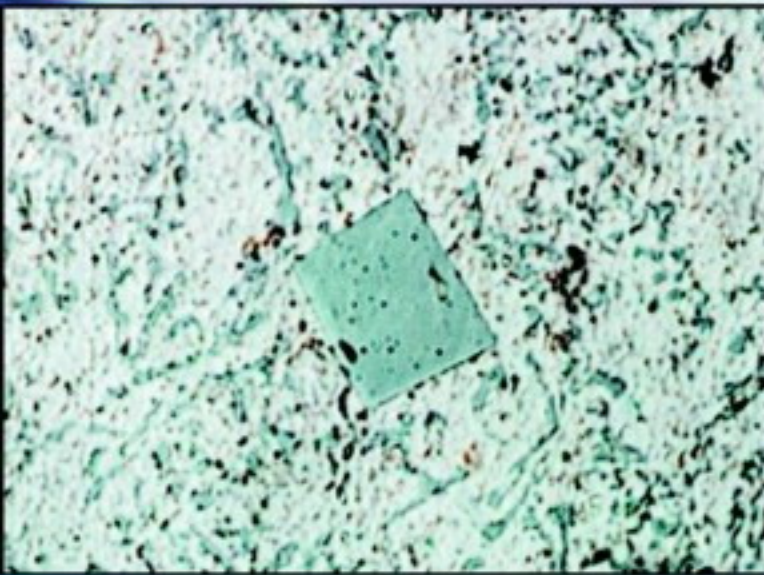


1. Metal receiver
2. Jet crystallizer
3. Jet-submerged secondary cooling device
4. Withdrawal device
5. Ingot



Method of quenching solidification casting

Description of process. The Alloy is poured in the water-cooled metal mold. The casting's initial rim with the thickness of 5-8 mm is formed. The billet is solidified in the quenching bath.



Microstructure of the AlSi18Cu1.5 casting with a diameter of 45 mm, x3000

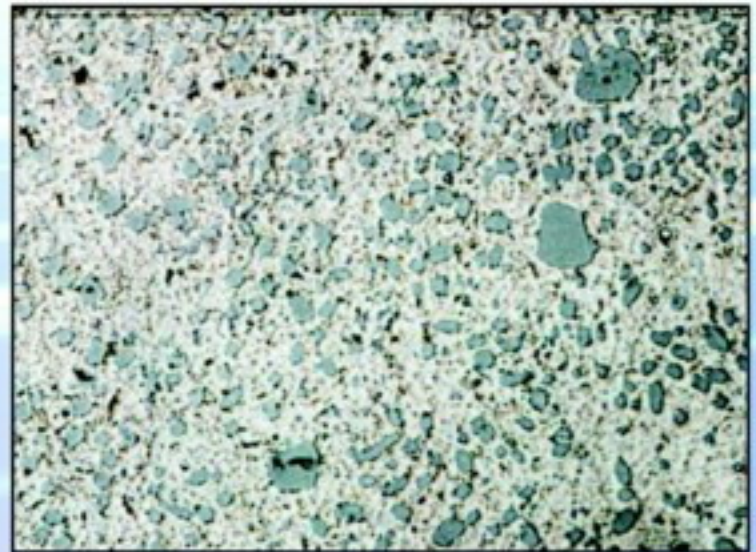
Application area

The method can be used for:

- casting of silumins with nanostructure eutectic silicon;
- production of deformable cast alloys, for example, silumins;
- casting of antifriction alloys with improved mechanical and operation properties;
- essential improvement of structure heredity and mechanical properties of silumin billets.

Advantages

The production process of quenching solidification casting is ecologically safe, eliminates application of modifiers, ensures high output and production of castings with nanostructure eutectic silicon.

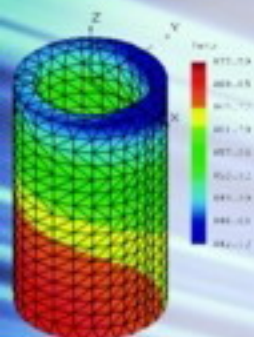


Microstructure of the AlSi18Cu1.5 casting with a diameter of 45 mm after normalization at 500C for 4 hours, x2000

Main characteristics

Billet diameter	40-150 mm
Output	0.5-2 t/h
Dispersibility of primary silicon	5-30 micron
Dispersibility of eutectic silicon	0.4-1.5 micron
Microstructure conservation time under remelting	no less than 2.5 h

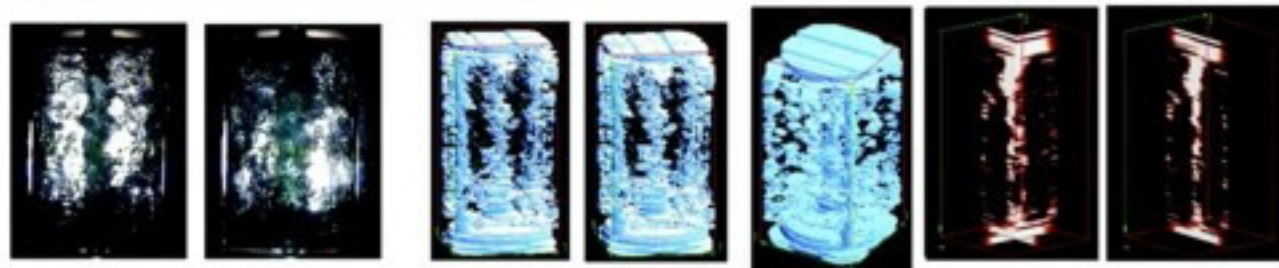
Mathematical simulation of casting processes



The Institute is engaged in solving:

- heat and thermal deformation problems of solidification of ingots and castings of any shape;
- crystallization problems of metals and alloys;
- water analog simulation of the mold filling process under die casting;
- multicriterial optimization problems for casting and other production methods.

Problems are solved on the basis of 2-D and 3-D mathematical simulation with determination of phase transition boundaries allowing for nonstationarity of casting processes and nonlinearity of thermophysical parameters.



Software for quick processing of blurred and distorted images

Software for quick processing of images, distorted and blurred at passing through scattering medium. Author's original algorithms, used in this software, minimal possible mean-square error of recovery of initial object.



Main advantages of the offered processing system are possibility of maximal gain of resolution limit of recording system with consideration of its characteristics and possibility of processing of several images. It is mathematically proved that for the chosen class of objects, gaining higher resolution of the given system is impossible.

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