



IMPLEMENTATION OF NANOCERAMIC COATINGS IN INGOT PRODUCTION

High performance provided by a 20µm ceramic layer...

Once implemented, the use of the nano-ceramic coating is simple. But the switch from agents or lubricants to a semi-permanent ceramic coating requires the respect of some rules



Principle and advantages

Machines, Devices, Products

Step by Step Instructions

Additional Information and recommendations

Annexes

PRODUCT: **nanocomp MI10**

Developed and produced by

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Principle and Advantages

The product Nanocomp MI10 is developed for its purposes, not just chosen ...

Design goal of the development of Nanocomp MI10 was to achieve a noise-free, efficient production in primary aluminium ingot casting. Maintenance of mould and coating should be reduced to a minimum to grant best efficiency of the installation and high productivity. No product and workspace contamination should occur from the coating.

A big pain in the economic efficiency of conventional processing is the need to clean all moulds from time to time. This may happen 1-3 times a year. Shot blasting/cleaning all moulds is very expensive and leads to a non-availability of the production device for 3-5 days per initiative. Production capacity – and in this way the creation of values – is lost.

Using carbon based agents, products may be contaminated by organic condensates. This is a price relevant quality issue. It may also lead to non-acceptance. Oil based agents are applied 1-3 times per day, which represents a high cost and affects the environment.

These issues are solved by this ceramic product.

REALIZED DESIGN GOALS OF NANOCOMP MI10

- The ceramic layer of **Nanocomp MI10** protects the mould from too early cracking.
- In standard casting machines the poured aluminium must solidify and shrink within 6-8 minutes. **Nanocomp MI10** is designed to provide its functions over a couple of weeks when being applied thinly: 5-30µm. Such a thin layer cannot be considered as a heat transfer barrier. This coating grants a rapid solidification and cooling of the ingot.
- The ceramic layer of **Nanocomp MI10** doesn't contain any organic ingredients. So, a surface contamination of ingots (black traces) is excluded.
- The release properties of **Nanocomp MI10** are as good as graphite or oil.
- The very thin layer of **Nanocomp MI10** is worn after 1500-2500 castings (depends mould size and aggression). A coat repair happens rarely. It requires few coat material and takes ~40 minutes. A significant coat build-up was never observed. So, there's **never** a need to stop production for mould cleaning in a moulds life.
- **Nanocomp MI10** is an inert, non-reactive coating. Smoke exposure and fire incidents are excluded.

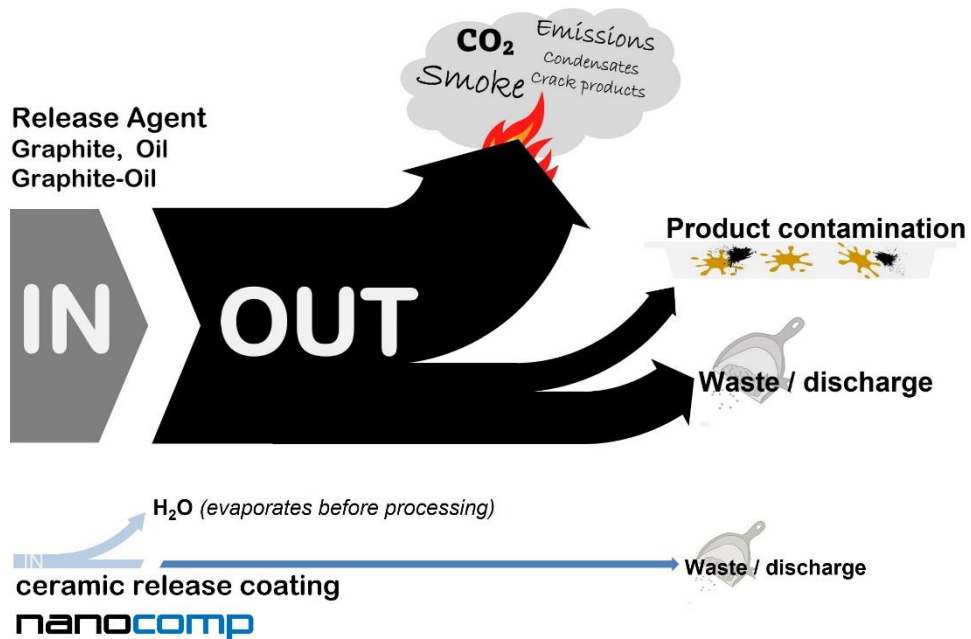
Many cost relevant advantages occur from the features mentioned above. In addition to that, a noise free, non-interrupted processing supports the efficient and clean production.

OVERVIEW OF ALTERNATIVES

	OIL (GRAPHITE OIL)	Nanoceramic nanocomp MI10	Boron nitride Other minerals
Mould protection	☹️	😊	😊
Heat transfer (Line Speed)	😊	😊	☹️
Release effect	😊	😊	😊
Avoid Contamination	☹️	😊	😊
Avoid mould cleaning	☹️	😊	☹️
Low frequency of application days of service:	☹️ 0,3-1	😊 200-300	😊 4-6
Cleanliness	☹️	😊	😊

Impact on environment compared to Oil/Graphite

Reducing emissions becomes more and more important in the smelting industry. The impact of the release coating on the worldwide climate may be considered as low, but it is significant for the direct ambience of production. Volume of coat layer substance is only 1.8% of the graphite/oil volume.



(based on recorded data at a primary aluminium smelter)

Step by Step instructions

Nanocomp MI10 is a ceramic layer well adhering on the metal moulds. It does not adhere on residues of other coatings or agents. It adheres on metal surface or on its own.

That requires some precision and attention for the very first application. There are 2 options:

- Application of Nanocomp MI10 on shot blasted moulds → a
- Application of Nanocomp MI10 on new moulds (recommended) → b

This description is completed by a flow chart (presenting both options) and a short description (ideal to publish in the production). Both is attached in annexes.

1. Preparation

Read and respect product documentation MI10 and Material Safety Data Sheets.

a. PREPARATION OF OLD MOULDS

- Old moulds must be free of any agent, aluminium, greasing substances, oil. For this reason, it is required to shot blast all moulds. In case of remaining oil/graphite, the coating will not adhere and peel-off.
- Moulds are mounted on the machine
- Moulds are heated by the installed burner to >80°C. During preheating, the water cooling must be switched off. In some cases additional burners help to achieve this temperature.

b. PREPARATION OF NEW MOULDS

New moulds (mostly) are protected by a corrosion protection oil. This is a light oil, that burn away while processing.

- Make sure, there's no puddle of oil in the mould. Dry with a cloth if possible.
- Moulds are mounted.
- Start casting without any additional coating. The corrosion protecting oil is used as an agent. Cast each mould 25-30 times. Then the oil is worn and Nanocomp MI10 can be applied with the remaining heat of the last casting batch (moulds: 120 – 150°C even 200°C is allowed)

c. PREPARATION OF COATING

- Shake the MI10-bottle intensely for 1 minute. Stir it up, if provided in buckets.
- Don't contaminate with other substances and don't dilute the coating.
- Fill in the coating into the paint pistol container. Test function of the pistol and adjust volume.

2. Application of Nanocomp MI10

Ask Ceranovis for video material (movies) about application. <https://youtu.be/wQXTSKR1Y4E>

Starting point:

- Moulds are clean and warmed above 80°C
- Coating material is homogenized by stirring or shaking the bottle
- Paint spray pistol is connected to pressurized air (oil-free, 2.5-4bar)
- Paint spray pistol tank is filled with coating material (500grs)
- A good place to coat the moulds (close to casting wheel) is defined and good, safe working conditions are established.

ADJUST PAINT SPRAY PISTOL



- Open the spray angle dial a little to get an angle of ~ 40°
- Adjust the volume to get a fine flow of material. Adjust the volume, if considering, that consumption is too high. 180 – 220 grs should be consumed for 10 moulds. (This is best method to grant the correct coat layer thickness)
- Best to adjust pressure at the manometer to 2,5-4 bar

ADJUST (SPEED OF) ICM

- The ICM is moving slowly (~10 ingots/minute)
- The cooling system is switched off
- NO CASTING!!!
- A supporting operator is available

START COATING PROCEDURE / COATING CONSUMPTION / COAT THICKNESS CONTROL

- Heat up and measure mould temperature. Start if > 100°C :
- Apply a fine homogeny layer on the entire inner surface (cavity) of the mould
- Record your consumption and try to achieve 180-220grs per 10 moulds. (Fill the pistol tank with 500grs and try to coat 25 moulds). Adjust volume, if you're above or below. (Value is for 22.5-23.5kg / 50lbs ingots)
- Adjust speed of ICM if it's too fast / slow.
- Coat all moulds of the line in this way.

SINTERING OF COATING

- Let the machine make at least 2 cycles heated by the burner
- SWITCH OFF THE BURNER JUST BEFORE CASTING START
The burner provides moisture. That could lead to moisture issues / explosions.
- Start casting to sinter the coating. Must be done at least 48 hours after application.



Application pics

3. Corrective measurements

After the very first application, in some corners the coating may peel off. The reason is remaining oil in small cracks and corners of the mould, which is not removed by the cleaning or burning methods. If the mould bottom is affected, this must be corrected by adding some coating after 2-4 batches.

This phenomenon disappears after some days.

Other negative effects are unknown. Please contact Ceranovis.

4. Renewing coating layer / touch up

Touch-up: slight adding of coating in worn areas

Do to non-ideal coating conditions at the implementation (see 5.), a coat touch-up after first use may be required after 2 weeks. (600-1000 castings).

Later a performance of 4-6 weeks (1500 – 2500 castings – depends on aggression) is expected.

A coating touch-up is required if the mould metal is shining through and the coat at the mould bottom is washed away. If the user is not sure about the ideal moment to repair the coat, he should send pictures of the moulds to sales@ceranovis.com or his contact person at Ceranovis. Ceranovis will help.

For a touch-up, there's **no need to clean** the moulds or to remove the old coating.

Follow same steps as in 4. "Application of MI10", but focus **on worn areas only**.

There's no need and no positive effect, if applying on unworn coating new layers.

Go for next 4-6 weeks.

FOR ANY STEP ...

...Ceranovis offers support and guidance. For the very first application Ceranovis tries being present or to send an experienced engineer. We also offer special conditions for the very first application (if the local trading partner agrees). Please share important information with us allowing us to provide best service.

Recommendations

- The demoulding depends on the effectiveness of the metal cooling. A lubricant effect only helps slipping out, if the ingot is already released from the mould. Rarely the lubricant effect is required.

From pouring to demoulding there are mostly 6-8 minutes for the metal to achieve the solidification temperature, to solidify and to shrink a little to get free. Good demoulding depends:

- Low temperature of melt at casting (<740°C)
 - Good mould cooling in the ingot line
 - Belt speed
 - Number of moulds in a belt
- Use hot air for mould drying or switch off gaz burner just before casting start.
 - Ask for movie files of application.
 - In most cases the implementation goes well and the customer profits from the very first day. Please note, this is a completely new technology, requiring some precision and care. Be patient and success-oriented.
 - Plan well the MI10 implementation and its later use. Grant the availability of devices and material right in time ... also some spare material for touch-up. Check all requirements and documents. Keep in touch with Ceranovis.

CERANOVIS provides

- Coatings for Ingot casting Al, Zn, Cu
- Coatings for billet casting (casting table, refractory)
- Coatings for sow casting
- Coatings for LPDC/GDC

Get in touch with us

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Annexes