Non-heated ductile pouring with full quality control

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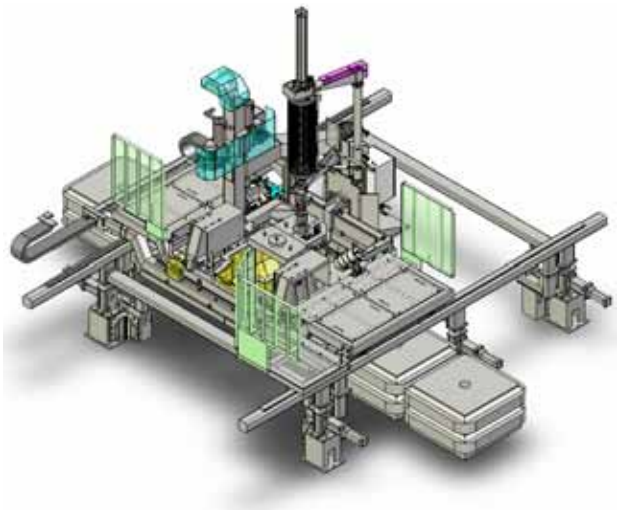
The KOINS pourTECH™ unheated pouring ladle is designed for the production of ductile iron. and is equipped with a lot of features to be able to have full control of this process and it is absolute necessary to have a number of different tools and the design of the ladle has to follow the production needs of the foundry.



Pic. 1 unheated ladle together with flaskline

The ladle size has to be calculated very precise in order to have full control of the iron temperature and the Magnesium fade rate. It is very important to have a continuous operation. The pouring ladle has a short residence time and is regularly replenished with hot iron from the holding or melting furnace, or the SG treatment process. For continuity of operation it is recommended to refill the ladle when the contents have diminished to 30% of the nominal capacity. In ductile operation, to avoid fading of magnesium treatment, it is recommended to size the ladle so that 70% of the ladle contents, equivalent to the capacity of the transfer ladle, are dispensed in 7 – 10 minutes. The temperature loss is normally 1 - 2 degrees per minute.

If the production line stops longer then the temperature specification allows, the ladle is emptied and re-charged with fresh iron when the line starts.

Frame Stand and Carriage

The ladle is mounted on a traveling frame equipped with flanged wheels and an electric geared motor arranged longitudinally with the molding line. The motor is normally operated at variable speed by an inverter drive. The frame features a maintenance platform, which accommodates other equipment such as stopper rod actuator, pouring control sensor and in-stream inoculation. The ladle is seated into the frame by means of guiding pins. This ensures a correct position of the ladle and makes it fast and simple to change ladle. The traveling frame is mounted on a cross travel carriage. This is carried on a gantry over the molding line with flanged wheels with an electric drive system. The electric drive can be manually controlled for accurate lateral/cross positioning of the pouring nozzle over the runner bush and for withdrawing the pouring ladle altogether from the molding line in the event of a plant stoppage to enable it to be emptied.

Under the control of the pourTECH™ automatic mode in combination with a vertical molding line such as Disamatic, the carriage automatically adjusts the ladle to position the nozzle precisely over the sprue cup.

Backtilt Frame

The ladle system can be equipped with a hydraulic actuated back tilting frame, recommended for ductile iron operation or when metal grades are frequently changed. This function also includes hydraulic power pack.

If no back tilt function is available, the ladle must be emptied via the nozzle. If operation of ductile application and pouring ladle is emptied though the nozzle, slag contaminations or solidified iron drops may enter the nozzle seat, causing stopper leakage at resume of production.

Pic. 2 empty ladle in back tilt

Pouring Sensor Systems

The pourTECH™ system features a variety of sensors, designed for different pouring situations. There are systems for vertical moulding at high speed as well as for flask line applications with other requirements. There are two available laser technologies, the traditional single point laser and the new 3Dlaser™ system. We also provide a vision technology solution that can be applicable for less complex applications. The design of the pouring vessel, the mould and the available space will dictate which sensor system that is the most appropriate for each application

Vision Technology

Vision technology is used for flask line applications where large pouring cups are used and positioning is not required.

Vision technology is not suitable for detection of the pouring cup for automatic positioning. The positioning function is relying on the pour cup location information provided from the molding machine.

Single Point Laser Technology

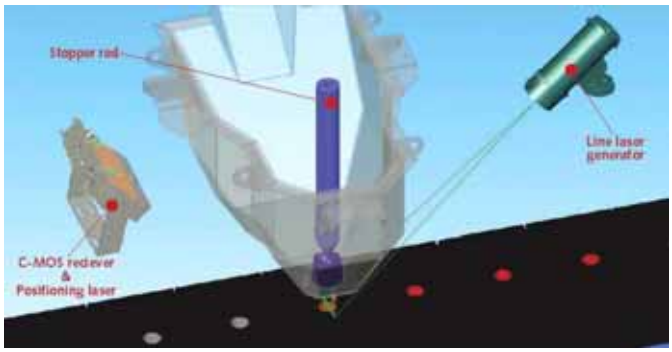
The single point laser system is suitable for high speed vertical mould lines. Since the measurement is done in a special area we call “laser tail”, the technology is applicable where there are extremely small sprue cups. It provides high speed and accuracy, allowing for peak control performance.

3D Line Laser Technology

The 3D laser™ system is suited for all mould line applications. The size of the sprue cup is recommended to be 2.5 the size of the nozzle diameter, still getting sufficient measurement data and high reliability.

The 3D laser™ system consists of a line laser generator and a 3-D Sensor. The two units are positioned on opposing sides of the pouring nozzle. The 3D sensor consists of a C-MOS laser camera receiver and a positioning (single point) laser.

Eliminates the need of laser tail



Pic.3 Setup of the 3D Laser

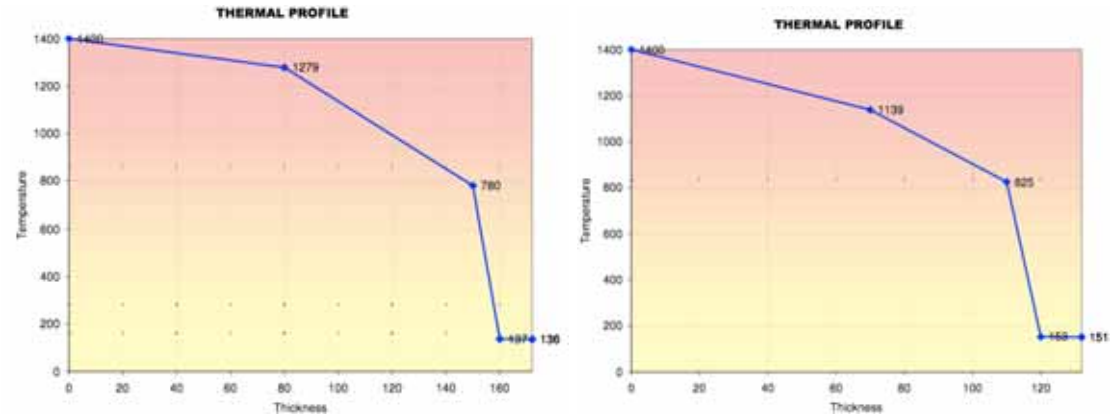
The Line Laser does not require the traditional “laser tail”, which means that you need less iron to fill the sprue cup compared to the single laser system.

Developed for a rough environment

The 3-D system’s two components are housed in water-cooled jackets made by stainless steel. The system includes a self-contained, closed loop cooling system, ensuring the optimum operating temperature. There is also an air purge system providing positive pressure inside the jackets, keeping dirt away from the sensor optics.

Refractory

By using high insulating refractory material the temperature losses can be reduced to a minimum. Therefore we will design the wall thickness and the design of the refractory according to the customer needs and production rate.



Pic. 4 Thermal profile / wall thickness

Load Cells

The KOINS ladle comes with precise pancake load cells which gives always the exact content of the ladle and the control system is using these information to optimize the dynamic range of the pouring performance compensating for the variation of ferro-static pressure in the pouring ladle. The load cell information is further used to inform the operator when it’s time to recharge the pouring ladle.

Stopper Rod Actuator

In order to ensure proper pourTECH™ operation, the stopper rod actuator must be both precise and responsive. The pourTECH™ system feature a new high speed electric servo drive in order to achieve peak performance.

The drive unit consists of the servomotor, operating a ball screw, which moves the actuator arm vertically in order to control the flow of the liquid iron from the pouring vessel into the sprue cup. This drive unit has been upgraded compared with earlier designs to ensure easy access.

The basic design of the actuator is for pouring grey iron, but it can be equipped with cleaning functions that are specially needed when pouring ductile iron. Read more about this in the sections of “Stopper rod twist” and the “Cleaning plunger”.

Pic. 5 Stopper actuator

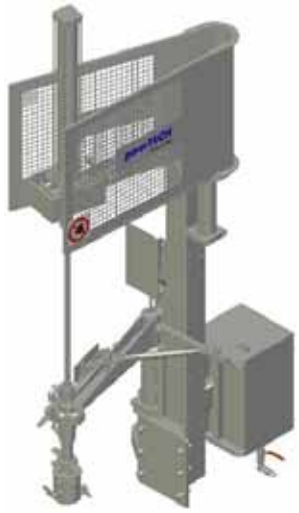
Stopper Rod Twist

The twist function will "jog" the stopper rod by automatically twisting it slightly while it is in the closed position. This allows it to "grind" away slag particles that are preventing a complete closing of the stopper – a common phenomena that causes the stopper/nozzle to leak. The operator is always in control of the twist frequency and has the ability to turn the function off completely.

Actuator Emergency Closing

The stopper rod actuator can optionally be equipped with an emergency closing mechanism. In case of power failure, a fail-safe connected pneumatic cylinder will ensure that the stopper rod closes, preventing the ladle from being drained of its contents of iron.

This is an essential feature when operating a non-pressurized pouring ladle.



Pic. 6 Stopper actuatot with cleaning plunge and twist for ductile iron

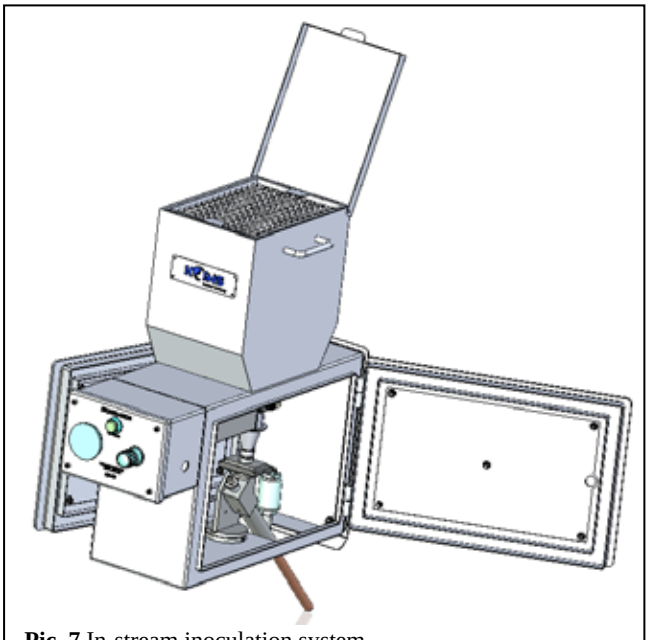
Stopper Actuator with Inline Plunger for Ductile Iron

Ductile iron has a distinct tendency to slag and clog up the nozzle. In order to prevent this KOINS also developed a cleaning plunger that is required together with the rod twist function when using ductile iron.

The nozzle cleaning function consists of a "plunger" that will send a "reamer" through the stopper rod and nozzle to knock out the slag that is building up in the nozzle. The system is not designed to open up an already closed nozzle, but to keep an open nozzle from closing up. This system requires the use of a hollow stopper rod.

Automatic In Stream Inoculation System

The in stream inoculation unit consists of a stainless steel, heat protected injection unit equipped with a screw controlled by a servo drive, making it possible to adjust the dosing. The unit maintains the pre-selected feed rate (auger rotation speed) at all time with an electric servo motor that controls the speed rotation of the screw conveyer and provides feedback to the servo controller.



Pic. 7 In-stream inoculation system

Integrated to pourTECH™

The in stream inoculation control can be integrated into the pourTECH™ automatic pouring control system, giving the pourTECH™ system full control over the inoculation unit. In doing this, pourTECH™ makes it possible to individualize the inoculation rate for each job. By controlling the timing of the inoculation signal, pourTECH™ can ensure that the first inoculants reach the pour cup together with the iron so that the entire casting is inoculated.

In addition, the pourTECH™ system monitors all alarms and can provide a quality record for every casting.

The integrated control system allows easy calibration of the feed rate and various monitoring functions and is designed for reliable operation

When delivered with a pourTECH™ system the controls for the inoculation unit is embedded in the pourTECH™ control system.

Inoculation control and monitoring system

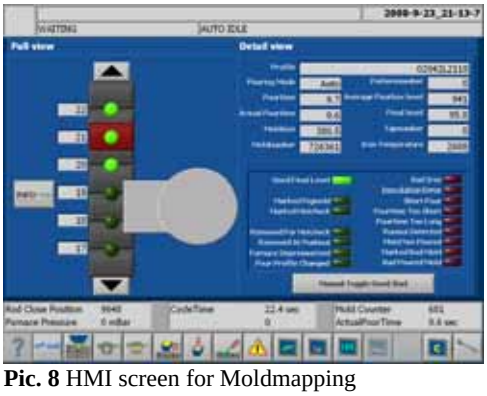
KOINS offers a fully automatic in-stream inoculation system for injecting inoculants into the metal stream during the pouring process. The system consists of:

- Dosing unit featuring a servo controlled screw feeder which accurately controls the feed rate in grams per seconds (the rate is controlled by the operator).
- Metal Stream Monitoring of the metal stream during the pouring process. This feature measures the amount of inoculants that is hitting the metal stream (hit-rate). In case of degeneration of the hit-rate, the control system will adjust the feed rate of inoculants. In the event the blow pipe gets misaligned or blocked, preventing sufficient inoculants to reach the metal stream, the system will stop the pouring and send an alarm to the operator so the pipe can be cleaned or replaced.
- The hit-rate measurement is performed with a special LineLaser Sensor System, developed by KOINS. Together with a separate controller, this Sensor System can be offered as a standalone unit to be used in conjunction with other brands of in-stream inoculation systems.

Mold mapping

For the quality management KOINS has developed a tool which is called mold mapping. The mold mapping function provides monitoring of all molds currently existing along the moldline, from mold machine to shake out. Each mold is linked with information such as pouring pattern number, pouring result, pouring time, final level, iron batch and mold thickness. Additional information from external machines/devices can also be linked in, if available. Examples of such information is mold number, pourbox level and iron temperature.

Via the visualization with the HMI, the operator has full access to information about each mold along the moldline.



Pic. 8 HMI screen for Moldmapping

Ductility fade timer

The pourTECH™ system keeps track of the ductility fade time of the iron in the pouring vessel. A timer is restarted by the operator every time the vessel is charged with fresh iron. A first warning is generated before the time has expired. If the time runs out, an alarm is generated and the machine stops pouring.

Iron batch control

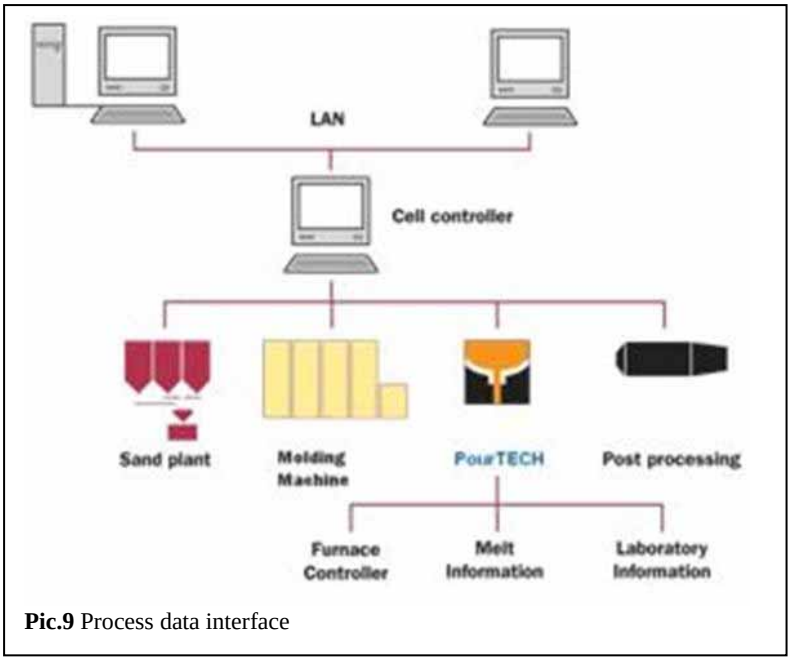
Every time the pouring vessel is charged with fresh iron, an iron batch number is incremented. The iron batch number is recorded together with the poured molds in the mold mapping register. Initially the iron batch is considered untested. When a spectrometer result is received from the test lab, the iron batch is marked approved or failed. If an untested or failed

batch reaches the end of the moldline, a signal is sent out which can be used to stop the line, light up an alarm lamp or whatever is suitable for the customer.

The mold mapping function can be used to also control other equipment such as automatic push outs and selection of different shake out programs.

Process Data Interface

Via the process data interface, pourTECH™ provides production statistics which customer can store for traceability. After each mold produced, the pourTECH™ system is sending out a



Pic.9 Process data interface

string of data including information about the last produced mold. This data includes information such as pouring time, final levels, pouring settings and more. The customer receives the data and stores it into their own database for production statistics.

Temperature control

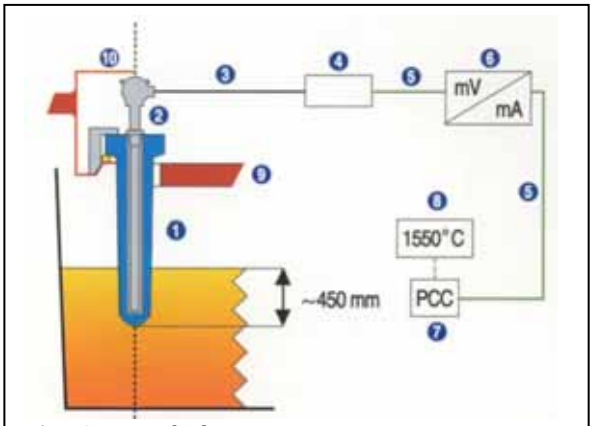
The temperature control of the iron can be done in two ways or a combination of both. It is possible to measure the temperature constantly in the ladle without opening the lids. The second way is to measure in the pouring stream.

Constant bath measurement:

The temperature device continuously reads the bath temperature in real-time at a representative and fixed location inside the ladle. Able to withstand harsh environments over a long period, the system is composed of:

An inner long lasting type B thermocouple, providing high accuracy and is enclosed in a molybdenum sheath.

An outer, disposable, refractory tube made of isostatically pressed graphitized aluminia. This component has a high thermal conductivity combined with corrosion / erosion resistance to molten metals and slag. The tube is replaced after each tundish change.



Pic. 10 Layout bath measurement

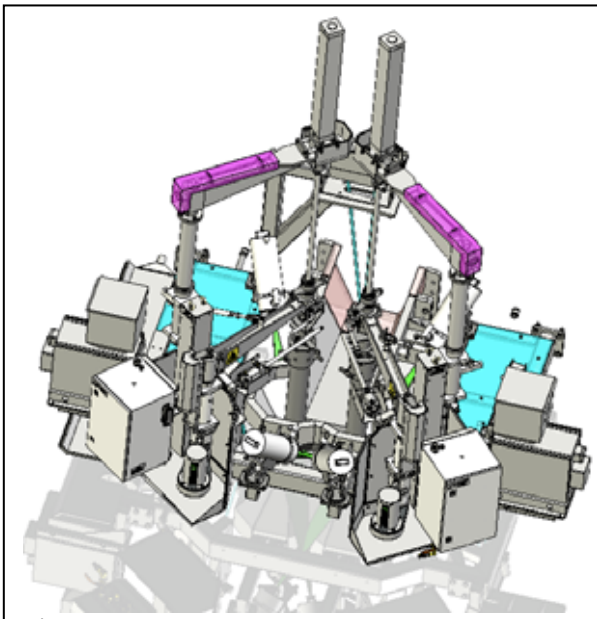
Pouring Stream Temperature Measurement

In order to get the actual pouring temperature, KOINS supplies together with the system a digital ratio pyrometer. This device is especially designed for industry and research applications. They utilize the 2-colour system which has the advantage of measurement widely independent from the emissivity. The solid compact housing and the standard protection window for the optics enables the use under rough environmental conditions. These pyrometers are suitable for the exact measurement of fast process with the very short response time (t95) of only 5 ms. Due to the focusable optics the pyrometer can be adapted optimally to any measuring distance and offers very small spot sizes of 1.2 mm.

The information of booth systems are collected in the pourTECH™ database and can be used for later purposes.

TWINpour™

Modern molding machines are increasing the moldrate to the point that it is not possible to pour the molds one by one, the mold‘s pouring time will be to short for proper mold fill, unless extremely light jobs with short pour times can be poured without decreasing the mold rate.



Pic. 11 TWINpour™ setup

In order to maintain the high mold rates while filling larger molds, the molds need to be poured two at the time. KOINS has developed a double pouring system (TWINpour™) for this application. TWINpour™ utilizes two 3D Line Laser based pouring systems, each operating independently from the other, to fill two mold at the same time.

The molding machine makes two molds and then will make a double indexing of the mold stack, and the TWINpour™ System begins pouring - as soon as the index is complete. The molds will stay in the pouring station for two mold making cycles, effectively doubling the available pour time – without affecting the overall mold rate for the line.

If you have problems with sand erosions, it is also possible to use the TWINpour™ System to reduce the pouring speed. The mold is filled with to gating systems at the same time.

This feature can be installed with unheated ladle and pouring furnace.

Final level optimization

KOINS have developed a new feature in the pourTECH™ pouring control system to optimize the final level in the pouring cup. This feature is designed for high speed mold lines where the molding machine is so fast, it does not allow the mold to be completely filled within the cycle time, causing the mold line to wait for the pour to finish.

By using an oversized pouring cup as a reservoir, it is possible to allow the molding machine to index while the

Pic. 12 Laser in cooling jacket

filling of the mold continues (and completes) – using the metal in this reservoir to complete the fill.

The Final Level Optimization function uses a separate laser sensor to measure the final level of metal in the pouring cup 1-2 indexes after it has been poured. The final level measurements are used as feed-back to the pourTECH™ system to adjust the pouring parameters for the next molds to be poured.