Image: Determination of melting point of aggressive slags – Vesuvius R&D
Innovation is at the core of all our activities. To stimulate this innovative strength we value creativity in all aspects of our processes and practices. Innovation in technology within Vesuvius is fuelled by:

AN INTIMATE KNOWLEDGE OF OUR CUSTOMER PROCESSES AND NEEDS
Our customer-specific knowledge comes from having over 200 field applications engineers working in active partnership with our customers. However, it is also essential to understand in depth the interaction of our products and systems with our customers’ processes and products. Most of Vesuvius’ products come into direct contact with our customers’ end-products and all of the systems provided play an integral part in their manufacturing processes. The end result is that Vesuvius products and systems play a crucial role in determining the quality of the end-product and the efficiency of our customers’ processes.

The impact which Vesuvius products and processes have on our customers’ product quality and process efficiency is a responsibility which we take seriously and it is with a focus on the maintenance and improvement of this quality and efficiency that we are developing and using state-of-the-art modelling tools to innovate new products and systems. Computational Fluid Dynamics (“CFD”), coupled with physical water modelling, is used to simulate our customers’ process flow patterns, including temperature, pressure and velocity distribution. The use of advanced simulation software for the casting and solidification process allows the prediction of final product quality. We have also developed a thermo-chemical simulation to predict interactions of our products in corrosive environments. Finally, newly-developed products are evaluated in our pilot testing facilities, which reproduce the difficult conditions of on-site applications.

STATE-OF-THE-ART TECHNOLOGIES IN PRODUCTS, SYSTEMS AND SERVICES
Vesuvius’ fundamental expertise, developed in six R&D centres and supported by eight development units employing over 150 high level graduates, is focused on ceramic materials designed to withstand extreme usage conditions. Application temperatures regularly exceed 1,500°C in aggressive molten metal, glass or slag, resulting in considerable thermomechanical and thermochemical stresses.

Vesuvius is developing, specific to the materials used in its products, state-of-the-art Finite Element Analysis (“FEA”) simulations in order to more accurately determine thermal distribution and stress gradients, so as to be able to optimise the properties of its products. The outstanding performance gained by using these refractory products is further enhanced by being used in combination with the complementary technically advanced systems developed by Vesuvius to optimise the safety, productivity and quality of our customers’ processes.

Three recent major innovations (two in the field of steel continuous casting and one in ductile iron foundries) illustrate well Vesuvius innovation providing quality service to our customers:
1. IMPROVED STEEL YIELD AND PRODUCTIVITY WITH TOTAL TUNDISH TECHNOLOGY SOLUTIONS ("T³")
A fully engineered, customised T³ solution to improve yield and productivity has significantly improved steel producing operations at one of the most modern thin slab casting plants in the world.

By working with steel plant engineers using computational fluid design of the ladle and tundish and water modelling and physical design of the tundish, Vesuvius engineers were able to recommend changes to the existing ladle and tundish refractory design.

By incorporating a combined ladle and tundish solution using ELBY™ and Yield Enhancing Systems ("YES") in conjunction with a complete Turbotstop™ tundish flow design the steel plant was able to justify a prolonged evaluation of the technology and practise change recommendations to verify the improved ladle and tundish yield. In addition, they were also able to modify their grade mix model to allow for a significant reduction in the mix grade casting losses to scrap.

Using the Vesuvius ITI process monitoring system, a rapid, online, sophisticated, infra-red, optical monitoring system, coupled with novel software that allows a quantitative evaluation of slag and steel in conjunction with normal steel plant accounting processes, they were able to verify the accuracy of all of the model predictions. This enabled the steel plant to accelerate full implementation in less than six months to take immediate advantage of the large cost savings, scrap reduction and productivity improvements.

As a result, the steel plant has been able to increase yield by 33.25 tons per casting sequence, which translates to a reduction of 242 ladles of steel being melted per year or an increase in prime yield of approximately 40,000 tons per annum or 1.2% productivity improvement.

2. ROBOTIC CASTING TECHNOLOGY ("RCT") WITH LADLE TUBE CHANGER ("LTC") AND SHROUD EXCHANGE MECHANISM (SEM 3085)
Vesuvius has focused its efforts at developing innovative technical solutions around the continuous caster targeted to achieve not one, but all of the steel industries’ critical objectives of improved Productivity, Flexibility, Yield, Quality, Safety, Cost and Environmental impact.

As a consequence, Vesuvius has recently launched the first products of our new Robotic Casting Technology range. The Ladle Tube Changer ("LTC") is a significant move in technology away from the traditional ladle shroud and collector nozzle joint to a flat plate joint with the ladle shroud no longer held in place by a manipulator, but becoming an integral part of the ladle slide gate system. This arrangement provides an improved yield of prime quality steel through the reduced possibility of reoxidation with a tighter joint and the ability to safely guarantee 100% submerged opening into the tundish. The system has also been designed to be robot compatible allowing the entire ladle shroud operation, including shroud cleaning, to be achieved without human intervention, thereby removing the operators from the most exposed and dangerous environment still existing in the steel plant today.
The latest robot-compatible tundish tube changer (SEM3085) has also been designed to reduce air aspiration and therefore also enhance quality, to increase flexibility and safety through the double stroke concept, allowing for an emergency shut-off at any moment in any situation and to maximise productivity and yield through a more robust refractory design allowing significantly longer sequences to be cast.

For devices such as the SEM3085 to achieve their maximum potential in terms of quality and yield it is also essential to provide extremely precise steel flow regulation. We achieve this with our SERT M type electric stopper valve and the new generation of Avemis ledge type eddy current mould level sensors. Ledge sensors are fully compatible with all other electromagnetic actuators employed in the mould, such as electromagnetic stirrers and brakes, and do not interfere with the tube change function, as is the case for the conventional suspended sensors. The Avemis ledge sensor coupled with the precise SERT stopper control system therefore allows for accurate continuous fully automatic mould level control for the entire casting sequence maintaining prime quality steel production.

3. INITEK — AN IMPROVED METHOD OF PRODUCING DUCTILE IRON

The production of magnesium-treated ductile iron castings is witnessing a radical change in the way liquid metal treatment practices are performed. Foundries, worldwide, are fundamentally reviewing current processes in light of findings embodied in a revolutionary, patented, Foseco technology described simply as “an improved method of producing ductile iron”. Foseco has branded the metal treatment process as “INITEK”. INITEK dramatically improves the level of process control in foundries and the overall quality and cost for producing ductile iron castings. To achieve this, Foseco, together with key business partners, has developed a unique combination of new metallurgical products, analytical tools, process know-how, and a state-of-the-art metallurgical treatment vessel.

At the heart of the INITEK process is the patented, prism-shaped vessel commonly referred to as a “converter”; a specially-designed containment vessel for liquid iron used in the foundry as a reaction chamber in the production of ductile iron. The interior wall of the converter vessel is lined with a novel KALTEK ISO refractory system, patented by Foseco, which promotes a high level of metallurgical process consistency and metal temperature control.

A unique ferro-alloy called INODEX is placed inside the converter vessel to “initialise” or remove unwanted elements from the iron, thus promoting an efficient chemical transition from liquid “base” iron to ductile iron with NODULANT ferro-silicon-magnesium alloy. Results are validated using a class-leading ITACA* thermal analysis system in combination with other conventional metallographic and physical tests.

Successful adoption of the INITEK process requires a detailed understanding of metallurgical processes and the ability to deliver highly customised, engineering solutions, to foundries. Foseco application experts work closely with foundry operations and engineers to design, fabricate, and install specialised equipment that when used together with Foseco products deliver value both in terms of financial savings and enhanced capabilities to foundries.

The many benefits of the advanced metal treatment technology for ductile iron castings are centred on a considerable reduction in liquid iron process temperatures in the foundry. Not only is a substantial energy saving obtained, but further benefits related to productivity, casting quality, and the consumption rate of refractories and metallurgical alloys are also achieved, delivering net savings to foundries in the range of €40–€120 per tonne of liquid iron.

*ITACA is a trademark of ProService Technologies (Italy). Foseco is the exclusive distributor of ITACA systems, worldwide.