

LOST FOAM CASTING IN THE EU: MARKETS, PRODUCTS AND DEVELOPMENTS

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INTRODUCTION

Lovink Technocast b.v. is within the Netherlands the only foundry now with a fully operational Lost Foam production line. After trials and a pre-production phase, a Vulcan line is running since 1996, starting with a large launching customer. Aluminium as cast material was added in the program since 2003 and produced within a separate company Lovink Aluminium b.v. In October 2004 the production of foam parts started, in a newly build factory. Tools for foam and gluing machines are supplied by the expanding tool shop, which is running now with 3 new CNC machines (3-5 axes). The CAD-CAM coupling is integrated and digitalized. Within the tool shop it is possible to produce at least 95% of complex tooling and tooling components for the production of assembled foam parts. Completion of all production steps means advanced flexible automation around the foundry line and the cleaning, inspection and machining area. This process will be completed in 2007. Scale, principle and methods of automation, especially in the cleaning, inspection and machining area, will of course greatly depend on scale of growth in the different market segments. Lovink is member of the Council (2003) and the Consortium (2004) and plays an active role in the spread of the knowledge on the process. These 2 days we will present 2 papers.

Figure 1 Lovink Technocast Lost Foam Casthouse

In the EU, at present, there are about 15 companies with Lost Foam casting production at a significant scale. About half of them are captive foundries. After a late introduction of the Lost Foam casting process, as compared to the US where the Lost Foam casting process originated, the EU production volume is maybe still somewhat smaller; the level of quality of the production processes and research however is now equal. Differences in approach and perception of the processes between the EU and the US will always exist.

It seems that by now, this list of companies is not growing fast anymore. Over the last 4 years one has seen, that some big early advantages of the Lost Foam casting process do not play such an important role anymore. There is still some growth in volume, in the material aluminium more then in cast iron, but it has to be said, that also some smaller companies had to be closed for various reasons. For more and rapid growth in different segments of the market, concentration on the real advantages of the foam process should take place. One of the advantages is that the Lost Foam casting process, as no other process, can help real innovations to come through.

Over the last 2 decades the Lost Foam casting process has grown to a process that reached the stage of maturity, meaning that most set backs in the process are solved. It is now evolving in a more smooth way, as it does with its concurrent alternative manufacturing techniques. Proof of that is also this first truly international meeting. When the new Lost Foam casting process was introduced, it opened up new markets with high speeds and developed as a casting process more widespread then it was thought to be from its

introduction start. At first it was thought to be a niche or specialty process. The widespread acceptance certainly has to do with the exploration of all the advantages of the process over the existing processes. No need to recall these advantages, this was done during so many occasions. So many examples of successful foam projects were described, that the disadvantages sometimes were neglected. There is a list of products too, that failed to be produced in foam. And it is not really a short list. Some of the mistakes are typical not for the Lost Foam casting process, but more typical when a current design is changed to a casting. After a steady growth over the years there is a little hick up, growth rates are not that big anymore, levelling takes place. For more growth, the real potential of the Lost Foam casting process should be put forward: its innovative power. An analysis of the list of (un) successful products will be of help to find its innovative power.

MARKETS FOR THE LOST FOAM CASTING PROCESS

As mentioned, the Lost Foam casting process has reached stage of maturity, but did the process of marketing or merchandising of the Lost Foam process the same?

In other words, when new components or parts are designed, are the designers at that level of skills that they know about ins and outs of all different casting principles and give those equal chances? This is still not the case, meaning there is work to do, to improve on the commercial, promotional and even educational side.

A glimpse on the participation list of this 2 days meeting show a lot of familiar names, which is good of course, never before there has been a sort of congress like this with so many participants of so many different nationalities, which is another proof of the maturity of the process. Beside of that, it is surprising to see the many new names on the list, all being potential users or customers of the Lost Foam casting process.

Figure 2 Foam production facilities

Figure 3 Lost foam casting facility

There are a few leads, which can be seen as stimulators for increasing the market shares of the Lost Foam casting process:

- Some customers are highly interested in new production processes. Companies, who form teams that travel around the world in search of new production processes. Processes that can either drastically reduce costs, increase quality or opens new possibilities in designs. No need to say, that only larger companies with vision and long term plans, can afford to do this. Based on engineering orders they have new processes and products tested, before starting any production. Find those companies, before they find your (Lost Foam) competition. These typically are the innovators, companies willing to take risks and being the first to try new innovations.
- Some patience is needed in combination with some financial reserve, when adopting the LF process for new innovative products. Customer's vision and courage also go together here. An influential designer, who is aware of the possibilities, can just make the difference to convince purchase management to continue the project to its successful end. This is often seen in companies that have a good eye for innovation and implement innovations with care, and so minimizing the risks.
- Some companies have very strict procedures as it comes to dual sourcing, in some cases different casting processes are required, but products should still be

interchangeable. This is not a good starter for the LF casting process. At the moment in the EU, dual sourcing capacity for only Lost Foam castings is too small. It would be better for the market when there would be more competition.

- When a first part was already successfully designed and produced in Lost Foam, the foundry is likely to be consulted again in the earliest stage of the design process, which gives the Lost Foam casting process, its best chances. Existing customers form a good source for new innovative products. Treat them with care.
- When a jobbing foundry offer more casting processes in a package, it can offer the best solutions in terms of price. Confidence level is higher when different approaches can be offered.
- In a new design, it helps a lot when machining operations can be skipped, or are drastically being reduced. The foundry should have skilled people who can fully take part in the discussion about the machining of the castings, in order to build in all possible machining time reduction possibilities.
- When the foundry is able to machine the parts itself, this gives the opportunity to deal directly with the customer and over the purchase department with the designer, thus best being able to influence on the design. With the LF foundry in the lead, it means that the advantages can be fully exploited in the designs.
- Of course combination of functionalities or combining different parts to one component is one of the strongest leads for successes in the market. It carries also the strongest innovative possibilities.
- New possibilities are created now with other base materials, the use of inserts and the combination of materials.

No strong leads are the following:

- Wrong price perception on the LF castings alone. More then ever, the integral part price should be calculated. The overall calculation can be made misty, when the savings are in the customer's own workshop. With a purchase department strong in charge, it will be difficult to convince people to use foam castings. This makes it difficult to compete with existing castings, if hardly impossible. New projects with separate new budgets, i.e. machining, show more leads. Budgets for machining investments can be cut drastically when using foam castings.
- Wrong (re) design perception when only invited to copy existing castings, produced by one of the alternative processes. These castings, when not produced on special lines can be purchased all over the world, i.e. in China. Chance of successful introduction of foam castings is practically zero.
- Too high expectations about the advantages, for example about tolerances. Some criticism can be given on the LF foundries when overestimating their ability to meet narrow tolerances. This happened in the first years of the introduction of the Lost Foam casting process and it gave some image problems due to some unsuccessful projects.
- Relation foundry/machining company not good (contradiction of skipping machining in relation to the core business of a machining company). Inability to communicate over the specific machining problems with LF castings (how to deal with glue joints, tolerances, etc).
- When customer tends to want to see or have no troubles at all, when he does not accept deviations in the pre-production phase. When he refuses or even ignores to accept from the beginning a somewhat longer development time for new products.

When he is not really being used to that, he is probably the kind of customer that form the so-called late majority (conservative ownership). Irritation stacks and at the end projects are stopped and the good name of the Lost Foam casting process is at stake.

Early successful projects have put the Lost Foam process on the map between the other alternative already existing processes. Earlier papers within the "Paderborn Symposium Vollformgiessen" can give you a good perspective. But this map is a technical map.

In the Market, the Lost Foam Process is still seen as a relative new innovative process. Let us look at the companies that have adopted the LF process, in terms of introducing their own production equipment (castings for internal use (captive) or jobbers) or as customers, so users of the castings.

Seen from the point of the description of the diffusion and adoption of innovation, it is helpful to use part of the theory of Rogers (1962). As will be explained later, there still seems to be a big gap between the state of the art of the current technical process, its high potential and the penetration of the process in the market. A gap will always exist here, but the gap is big, bigger then may be expected, when realizing about potential savings and advantages when using the Foam Process.

In the theory of Rogers, there is a difference in speed in which companies take over innovations. In principle there is a larger middle group (Early (34%) and late Majority (34%)), not faster or slower in picking up innovations. There is a group of companies that picks up earlier (The Innovators (2.5%) and the Early adopters (13.5%) and there is a conservative group that stays behind (Laggards (16%)). In this case the aspect of diffusion and adoption of the new Lost Foam casting process can be mapped. Full market penetration in total is 100%.

Lovink Technocast has performed a survey on the adoption of the new Lost Foam casting technology for cast iron in the EU late 2002 and was surprised to see, where we were on the Rogers curve. It appeared to be, that the Lost Foam casting process is in between the Innovators and the Early adopters, meaning that we still are in need of the innovative companies that are in search of new technologies. This means that there is still a lot to do in the promotional and educational area, to reach the designers. The Innovators may find the route to the foundry themselves. After starting to cast aluminium, Lovink has experienced the same.

Lost Foam Designer Days can bring a lot of new potential business, when influential designers hear at first from the Lost Foam opportunities.

Listed below are some of the important aspects of Lost Foam castings that indicate where to find the market segments:

- Internal (cooling or hydraulic) canals
- Integration of parts

Growing markets:

- Request for inserts (not only Lost Foam)
- Complexity in canals and product
- Integration of parts
- More aluminium vs. cast iron

PRODUCTS

Developments in alternative casting processes and especially machining operations have showed that some of the original big advantages of the Lost Foam casting process are not so big anymore:

- The speed of machining of castings has increased dramatically, meaning that initial accuracy of Lost Foam castings has become less advantageous, and expectations were high, especially in the Jobbers Markets. Important now are the possibilities of complete deletion of some of the machining operations and less (re)positioning.
- New methods of core making, less environmental hazardous, more accurate and stronger cores, made that in some cases initial advantages are lost in similar designs
- Increased accuracy and speed in the casting processes.
- Automation of practically all process steps (investment castings, sand- and pressure castings)
- Full integration of the design/production steps

Figure 4 A variety of lost foam castings

However on the other side also some of the initial hesitations towards adoption and spread of the Lost Foam casting principle have been tackled for most developments in a satisfying way. The saying from one of our American friends some years ago: The Lost Foam process is like a beautiful widow with 2 ugly daughters (leakage and expensive tooling) does not stand anymore. It became possible with increased surface quality and high fusion degree of foams and of course also proper gating designs, to successfully enter relevant market segments. Also with new cutting tools, fast automatic machining in the tool shop, pricing and timing of tools is not such a big issue anymore. In the captive industry this did not play such an important role. The saying meant more for the jobbing foundries. So the developments in the tools helped to solve the problem of the expensive tooling costs, but also took away part of the advantages of the Lost Foam casting process.

Figure 5 Examples of aluminium lost foam products

DEVELOPMENTS

There still is important research ongoing that also pushes the Lost Foam casting process ahead.

- Rapid Prototyping and Rapid Tooling
- Simulation
- Surface finish and fusion degree of the foams
- Addition of inserts in foams
- Coating less casting
- Combination of materials, alternative foam materials
- Reduction of deformation during casting process
- Reduce the typical faults, increase strength of the materials used in the process
- Offering more than only a casting: a complete component
- Integration of the whole design chain

- Integration of the whole production chain

Figure 6 Computer simulation of mould filling of a lost foam casting

CONCLUSION

Many new applications in the Lost Foam process are logical, almost natural, based on the many advantages that the Lost Foam casting process gives above the alternative casting processes. Many small advantages together were making the foam castings favourable in design, functionality, and price or otherwise. However different casting processes come together in a way, that at the end pricing is close, too close. In current market, where there is still a hesitation towards the change to the Lost Foam casting process, conservative attitude is prevailing. And that is logical from the standpoint of the customer. Why taking such risks?

Shooting on all market segments and looking at all relative small advantages did not really work the last 4 years to expand the business. It is time for a change. Most promising projects and newly started products, they all show new strong innovative aspects, often not only from the standpoint of the customer, who discovered the Lost Foam casting process for this reason, but also from the standpoint of the foundry, who found a customer with an outspoken drive for innovation and where he did his utmost to get it all out of the design in combination with the casting process. It is still the market for the innovators and early adopters. Lost Foam foundries and these customers fit together there, they only have to be brought together. The early and late majority, they will follow, they need to realize first that they may not be in the lead anymore, if ever. Concentration of all efforts should be within the first group.

Of course there is a difference in approach between the captive foundries and the jobbing foundries. For both however the drive for innovation plays a very important role, both will have the skills and the intention to have production in the EU. With the highly skilled staff people involved in the design and pre-production phase and the fully (or maximum) automated lines for the captive foundries and the flexible automated lines for the jobbing foundries, the conditions for growth and continuation of production of foam castings in the EU is best preserved. Perhaps even the jobbing foundries will have to take the lead now in some developments, typical for the Lost Foam casting process.

To stay on the cutting edge of the foundry technology, the Lost Foam casting process should be in the forefront of designer's heaven: the place or platform where there is a call for complete new innovative solutions. That will be the place for growth for the Lost Foam casting process in the future. Especially for further growth in many markets within the EU. Some of the papers ahead definitely show important innovations that will push the Lost Foam process ahead.