The lost foam process offers the greatest advantage to the production of castings which require complex cored passegeways, uniform wall thickness and limited or no draft angles. As the casting is a virtual reproduction of the moulded foam pattern, dimensional control is greatly improved over castings produced by the greensand route and for many features such as gasket surfaces and drilled holes, the improved dimensional control means a significant reduction in, or even the elimination of, machining.

Even though the process was developed in 1958, its commercial growth was slow due to limitations in moulding materials and technology and patent restrictions. In the late 1970s interest in this process was stimulated as foam moulding technology and materials improved and the patent restrictions on the process expired. During this period, several major automotive companies began independent development and assessment of the process and as a result of their activity, Ford, General Motors and Teksid (Fiat) each set up production foundries producing aluminium automotive components.

As the materials and process know-how developed further, the lost foam process expanded into the production of iron castings including crankshafts, cam shafts, valve bodies, electric motor housings and engine blocks.

By the mid-1980s there were some 100 lost foam foundries worldwide producing ferrous and non-ferrous castings and currently it is estimated that in North America alone there are 100,000 tonnes cast per annum across all metal types (AFS Lost Foam Conference, Birmingham, Alabama, 1993).

Slow world growth of the lost foam process over the past few years has probably been partly due to the problem that the foundry industry in general has had of underutilised capacity. Current indicators are however, that there is a renewed interest in the process. The average growth for the lost foam industry over the past 10 years has been estimated at the rate of 10% per annum and this trend is expected to improve over the next few years as economies improve and capital projects move ahead.

The production process

The lost foam process begins with the production of a precision moulded foam pattern made from low density expandable materials such as expandable polyurethane (EPU) and, more recently, specialty materials developed specifically for the lost foam process such as Dow Chemical's expandable Poly Methyl Methacrylate (PMMA), Fosco's Low Carbon Bead equipped with precision fixtures to support the individual moulded components. The most popular adhesives are EVA hotmelt offering minimum glue deposit and a fast cycle time.

The assembled patterns are fixed to a runner/down sprue system, either moulded or fabricated from the same material as the patterns. Several patterns may be clustered to the runner system, depending on the size of the pattern and the moulding flask.

The cluster is dipped in a refractory type coating and dried. The refractory coating is designed to form a barrier between the pattern/molten metal and the sand during metal pouring.

The cluster is then positioned in a moulding flask and the flask filled with un-bonded sand which is compacted through vibration around the clustered pattern. A pouring cup is then attached to the runner/sprue system.

On pouring, molten metal vaporises and displaces the clustered foam patterns. After solidification the castings are extracted from the flask and separated from the runner system.

The castings require a minimum amount of cleaning and finishing as the patterns are free from the traditional parting line and core flash.

Is lost foam in your future?

The lost foam process should be considered as a possible addition in any foundry modernisation plan. While the process is not ideal for every casting situation, it is gaining in acceptance and, failure to consider it could be a major oversight.

But why do experts consider that the process is worth this attention? It differs from other techniques primarily in the following ways:

- No core; no parting lines; uses dry, unbonded sand; no mould wall movement; tooling is not subjected to foundry wear.

These differences result in numerous advantages to lost foam over conventional foundry processes including:

- No core related defects, shift, float or fins
- No core removal
- No core equipment, handling or hazardous materials
- No shift or parting line grinding
- No parting line limitations to design
- No moisture or binder related defects
- Easily recycled sand
- Very low, clean solid waste
- Low emissions
- Reduced blasting, grinding and finishing
- Improved working conditions - lower insurance rates
- Lower energy consumption
- Close dimensional tolerances
- Unique surface finish
- Decreased or eliminated machining
- More complex shapes - design freedom
- Low/no/reverse draft
- Casting weight reduction
- Improved pressure-tight castings
- Multiple parts - reduced assembly
- Cast-in inserts
- Extremely long tool life
- Straight forward process control
- Lower labour costs
- Lower capital costs.

With all these potential advantages, particularly the environmental aspects, it is easy to see why lost foam should be considered as a potential part of any modernisation plans. Foundries, however, have been somewhat reluctant to initiate the process for a number of reasons. The problem of under-utilised capacity has already
planks of wood are burned and the gases so produced are converted into useful steam and electricity. The residue of burning is ash which is used as a fertilizer.

The production of coal and coke from coal is a continuous process, involving various stages. The process begins with the extraction of coal from the mine. The coal is then washed and cleaned to remove impurities. After this, it is sent to a coal yard where it is stored until it is needed. The coal is then transported to the coal plants where it is burned to produce steam. This steam is then used to power turbines, which generate electricity. The byproducts of this process, such as ash, are also collected and transported for further processing.

The process of coal production is a complex one, involving many steps and different industries. It is a crucial part of our energy supply, and efforts are being made to improve the efficiency and sustainability of the process. The use of coal is likely to continue for some time, but there is a growing focus on finding alternative sources of energy to reduce our dependence on coal.
board motors. The approach Mercury took was to use the flexibility in design that lost foam offered to simplify the post-casting processing of the engine block. They were able to reduce a significant number of combined finishing and assembly activities over the diecast engine block by combining three castings into one. The net result of Mercury’s effort was an reduction in the overall assembled weight; reduced machining and assembly costs; improved engine efficiency through increases in engine water cooling; elimination of head gasket warranty claims.

Mercury’s experience has been so positive that they moved onto producing a V-6, three litre, 225Hp performance outboard engine block and a two cylinder 20Hp outboard engine.

Independent jobbing foundries have also had marked success in capitalising on the process. Alexander City Casting Company, Citation Foam (both in Alabama), Willard Industries, Cincinnati, Ohio, and Cagiva’s Dogo Foundry near Milan, Italy, have experienced solid growth over the past few years.

Newcomers to the lost foam industry include Alexcon Foam Cast Limited, India, Babcock and Wilcox, Dayton, Ohio, ARBOMEX, Mexico, Anhui Jin Hong, China, Handtamm Metallgiuwerk, Germany and BMW also in Germany.

### LOST FOAM FOR INDIAN FOUNDRY

The British company Auto Alloys has reached an agreement with Gujarat Metal Cast Industries to bring the first lost foam technology to India.

In what is initially a three-year deal, the Derbyshire firm will design a new plant plus machinery at the 60,000ft² Gujarat foundry and provide training for the 250-plus workforce.

“We have brought in the type of experience that money cannot buy”, said Gujarat’s managing director Chandrakant Patel.

“Auto Alloys were the creators of ferrous lost foam production for automotive components”, he added, “so they are extremely knowledgeable about the whole process. The benefit to be gained from this new technology is what our country has been crying out for.”

The contract follows Auto Alloys’ recent agreement with Pacific Basin Cast Components in Korea and has happened at a crucial time for Gujarat who are about to be flooded in India.

“Our knowledge of lost foam will give Gujarat added value”, commented Auto Alloys founder Dan Taylor.

### LOW-COST, ONE-STOP SHOP SUPPORT FROM CASTINGS TECHNOLOGY INTERNATIONAL

Cti (Castings Technology International) in Sheffield, England, has been involved in the development and operation of process technology utilising expanded polystyrene patterns since 1975.

Over this period, and especially recently, investment in capital facilities has positioned Cti at the very forefront of impartial provision of support services to casting producers and users interested in objective assessment or adoption of the technology. These facilities include:

- The Casting Design Centre at Cti which has state-of-the-art capability to optimise designs for functionality, quality and cost using high-performance software.
- High-performance computer aided machining systems for manufacture of precision tooling; five foam-blowing machines, the largest capable of accommodating dies 1.5 x 1.5 x 1m (all currently working), new dies being added every two days; a foundry with seven ferrous and non-ferrous melting units and production-scale casting plant.

These facilities are all available for ‘real world’ products - more than $1million of aluminium dies, polystyrene replicas, prototype castings and pre-production batches of castings were made in 1995, so it is a legitimate claim that Cti is well-positioned to provide substantive, all-embracing support.

Lead time to full production is shortened dramatically, since everything is proven under one roof - any modifications to tooling, for example, being rapidly executed based on first article inspection of foams and/or castings made at Cti. This is a very valuable feature to companies already engaged in the technology who, as well as those interested in evaluating and adopting the technology, exploit to the full Cti’s fast, low-cost prototyping service.

A range of techniques for producing one-offs has been developed to give confidence to commit to the process or to production tooling.

For those contemplating capital investment, the risk can be minimised by Cti proving the performance of the process on specific products of interest. Furthermore, it can specify hotline, entry level plant and equipment with upgrade plans to large-scale facilities and has project managed facilities of capital cost from as low as $100,000 to more than $2.5 million.

Strategic alliances now exist between Cti and about 30 foundries around the world who exploit its capabilities to the full. A particular growth area is in Replicast, a technique designed for materials which are intolerant of carbon pick-up from the polystyrene. Because there the pattern is removed when forming a thin ceramic shell which coats the pattern, high density replicas can be used. These impart to the casting a high quality surface finish and exceptionally good tolerances - very similar to lost wax but without the cost and physical size constraints associated with that process. Castings with a finished weight up to 500kg are being made by Replicast. The attributes of castings produced by this process are so attractive that several casting users have installed their own foundries for internal supply of precision, high quality castings, for pumps and valves, for example. In a vertically integrated operation, substantial end-product cost savings can be made.

In every case where close co-operation exists with Cti or business volumes, both in lost foam and Replicast, are growing dramatically. This is largely a consequence of the rapid response to prospective market opportunities combined with the confidence and comfort customers derive from seeing for themselves the competent, one-stop shop, third-party support which exists in the partnerships between Cti and the foundries in question.

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