Energy saving using SIVEX FC filters

The increasing use of non-ferrous metals for more sophisticated applications has led to ever greater demands for major improvements in metal quality. To remain competitive, foundries now have to be more cost conscious and the production of reject parts, particularly at the machine shop stage, being costly, is therefore, unacceptable. A major development, which has gained acceptance over recent years is that of foam filtration, and continual product development allied to improved understanding of applications can now offer the non-ferrous foundry industry even greater savings.

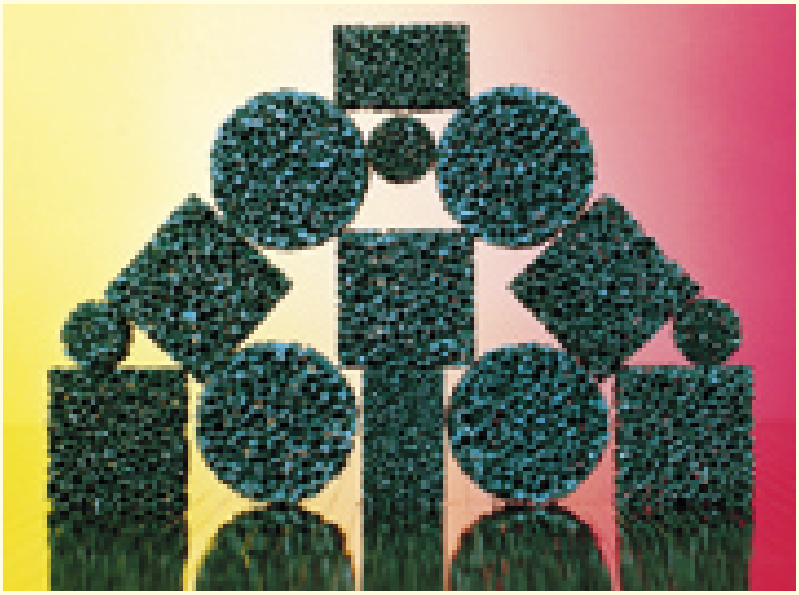
The development of non-ceramic SIVEX FC filters, which can be safely and simply separated during re-melting, has made foam filters easier to use. This, in addition to the direct pouring application of the product, offers the foundry industry improved quality combined with reduced manufacturing costs.

The potential offered by foam filters is such that the Energy Technology Support Unit commissioned a study as part of the UK Department of the Environment's 'Energy Efficiency Best Practice Programme'. The study was made at five foundries, looking in detail at quality, energy and labour costs, using both conventional running systems and with SIVEX FC filters.

Copies of this Case Study (No. 228) are available from:
Energy Efficiency Enquiries Bureau, ETSU, Harwell, Didcot, Oxfordshire OX11 0RA
Tel: +44 01235 436747 Fax: +44 01235 433066
Telex: 83135

Below is an extract taken from this publication.

The use of filters for molten metal in non-ferrous foundries



Ceramic Filters

Filtering liquid metal prior to casting can provide a cost-effective way of improving product quality and reducing operating costs. Despite this, many foundries still do not use filters, generally because they are unaware of the overall cost benefits that they offer.

These Case Studies describe the benefits achieved by five foundries using ceramic filters in the manufacture of castings. Four of the foundries cast mainly aluminium, while the other is almost completely devoted to the production of copper-based alloy castings. The benefits achieved include lower scrap and reject rates, improved quality, and reduced energy, metal, sand and labour costs.

The increased use of filters in UK non-ferrous foundries could realistically save almost £6 million/year, of which energy contributes £1 million/year.

Savings achieved

The total energy cost saving for the five products monitored was approximately £3,000/year for 30 tonnes of good castings produced. Non-energy related savings of over £15,000/year were also achieved.

For each casting, the total cost savings ranged from £2,100-£5,500/year.

Background

Foundries are under increasing pressure to improve the quality and reduce the cost of their castings. One way of achieving this is by filtering liquid metal in the downsprue or runner bar. This allows the rate of flow to be controlled while removing entrained debris, for example metal oxides and small pieces of moulds, cores, ladle and furnace linings which would otherwise remain as inclusions in the castings.

Fibreglass and steel screens have been used for many years, but more recently ceramic filters have become available. However, many foundries do not use filters at all. The aim of these Case Studies is to show how five foundries, differing in size, process and product, use filters to reduce their operating costs.

The benefits vary depending on the casting, the process and the foundry, but normally include:

- Reduced scrap and reject rates.
- Improved customer confidence.
- Higher overall yields.
- Reduced energy, metal, sand and labour costs.

The cost of adjusting patterns or dies to accommodate the filters is minimal. The actual filters cost less than £1 each.

The monitored sites

Five foundries, using ceramic filters in their castings, were monitored.

Economics

The five products monitored achieved total energy savings of 931 GJ (primary energy) for 25.4 tonnes of good finished castings; this equates to 36.65 GJ/tonne of good castings worth £210/tonne. Total cost savings were £638/tonne.

The cost of installing the filters was minimal, giving rapid payback periods – a few days to a few weeks – on all five products.

National potential

Annual UK aluminium castings' production includes 50,000 tonnes made in gravity dies and 15,000 tonnes in sand moulds. Assuming that only one third of these currently have efficient filters in the running systems and that 20% of the remainder could benefit from their use, total cost savings of approximately £5.5 million/year could be achieved by UK foundries. Of this, energy savings of more than 300,000 GJ would contribute £1 million/year.

The production of castings in copper-base alloys is much lower. However, increasing the use of ceramic filters to another 1,100 tonnes of castings would result in cost savings of approximately £500,000/year.

Comments from the monitoring consultant

The pressure on foundries to provide castings of high quality at low cost has never been greater. Buyers today expect levels of quality and service which far exceed those of even a decade ago. Foundrymen, therefore, must conform to this concept of continual improvement or go out of business. The foundries which have co-operated in this case study have all shown a way in which they have improved customer satisfaction whilst enhancing their own profitability. They have made excellent use of ceramic filters in the running systems of the castings illustrated.

Cost savings have been achieved in many different areas, in melting less metal, in lower metal losses, in reduced levels of chemically-bonded sand required, etcetera. Energy savings, whilst significant, are seldom the major element of financial gain. The estimates of savings are, if anything, understated and many other real benefits cannot be quantified.

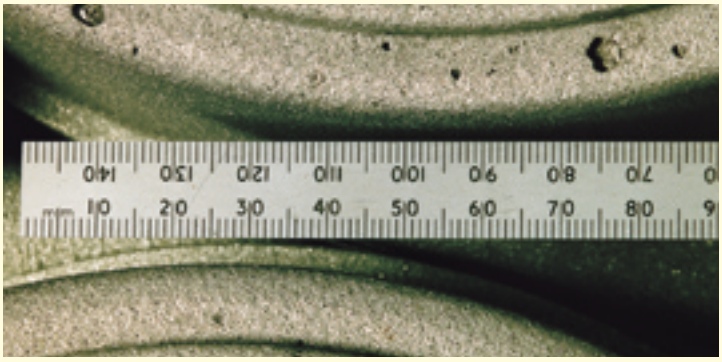
I hope that this case study will encourage all non-ferrous foundries to consider how they can benefit from the use of filters.

Mr S D Apsley
Monitoring Consultant

Sandwell Castings Ltd

Sandwell Castings is a large non-ferrous foundry producing castings in gravity die, greensand and CO_2 process moulds for a variety of markets. Most products are made in aluminium alloys, but yellow metals are also cast. Melting is carried out in coreless induction furnaces and the company has a number of holding furnaces with dual-fuel burners capable of burning oil or natural gas. Extensive use is made of filters in both die and sand castings. The type of filter used depends on the nature of the job; both simple fibreglass screens and foam filters being used.

Virtually all the castings are poured by hand, making product consistency difficult to maintain. However, the introduction of a foam filter in the running system has alleviated this problem by allowing metal flow to be controlled 'automatically'.

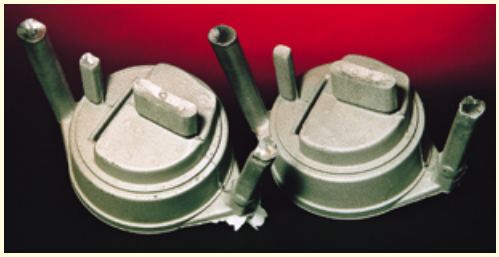


The filter has reduced scrap and reject levels by two-thirds, saving £1.72 on each 2.42 kg fettled weight casting (See table 1).

	Without filter(£)	With filter (£)	Saving (£)
Melting	1.37	0.84	0.53
Metal loss	0.48	0.29	0.19
Labour	3.92	2.41	1.51
Filter costs		0.51	(0.51)
	5.77	**4.05**	**1.72**

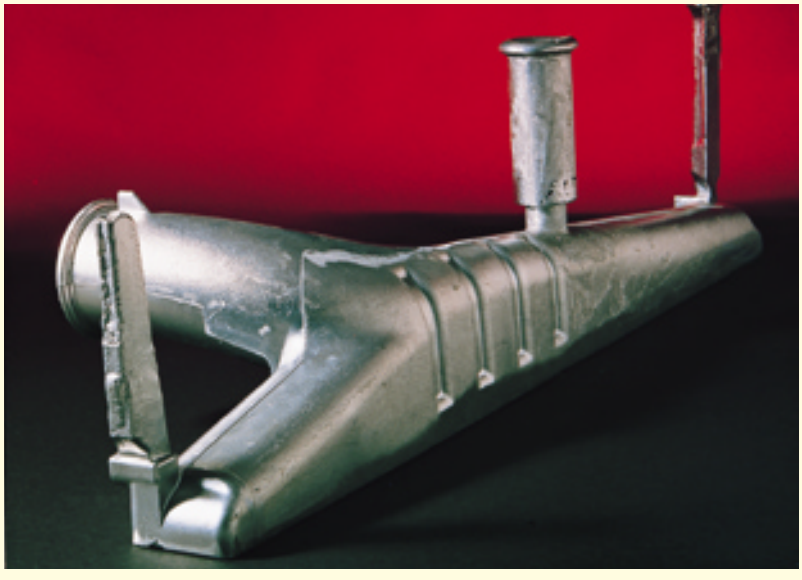
Table 1: Cost per good casting

Filters are also used in sand foundries to reduce inclusions resulting from turbulence and/or mould or core breakdown.



Two filter support gravity die castings after shot blasting showing how use of a SIVEX FC filter in the downsprue reduces the effects of turbulence.

Valcast Products Ltd



Radiator top tank

Valcast Products manufacture aluminium castings in gravity and low-pressure dies. Each process has its own advantages which are carefully evaluated for individual projects. The wide range of clients includes manufacturers of automotive parts, lighting arrays, tools and consumer goods.

Valcast produces a radiator top tank, made in LM6 as a gravity die casting, for a commercial vehicle. The sizeable, thin-walled component initially presented problems and every casting had to be sent to specialists for vacuum impregnation. This was resolved by the installation of a 10 ppi (pores per inch) ceramic foam filter in the single downsprue which allows the 3.44 kg casting to be made successfully without impregnation. Direct savings, net of filter cost, are £1.76 per casting worth £3,400 per year.

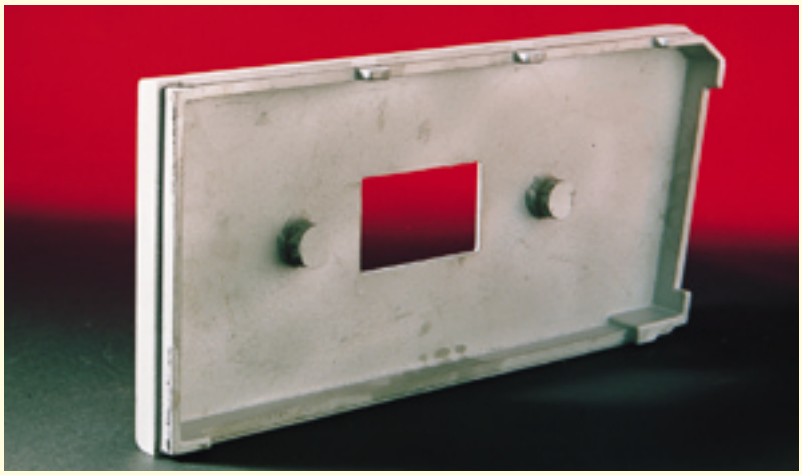
Barron-Clark Castings Ltd

Barron-Clark Castings produce some small gravity die castings. However, most of the company's products are produced in sand moulds using aluminium alloys and occasionally gun metal. At present, the foundry does not operate a sand reclamation system.

Foam filters, sometimes incorporated in refractory pouring sleeves, are used in every sand mould. They not only assist in reducing the incidence of non-metallic inclusions in the castings but also allow substantial savings to be made in the quantity of sand used. For example, before the use of filters it was common to place runner bars on each side of the two metre-long aluminium balustrade castings. Now, they are simply poured through filters located on the top. This significantly reduces the width of the long moulds and hence the amount of resin-bonded sand required. In addition, the quality of the castings has been improved and fettling requirements reduced.

Similar considerations also apply to automotive parts. The sump casting shown here is poured directly through a pouring sleeve with a filter in its base. The benefits include:

- Reduction in poured weight from 11.5 kg without filter to 7.5 kg with a filter;
- Reduction of 3.5% in scrap rate;
- Reduction in the cost of moulding sand mix.



Engine sump

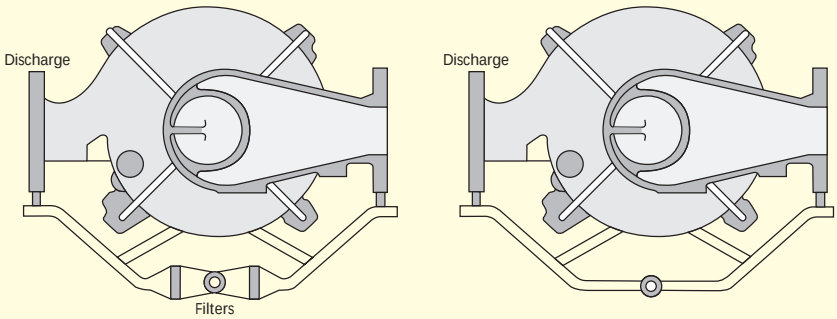
This gives direct cost savings of £3.62 on each 6.25 kg casting, worth approximately £4,300 per year, see table 2. Additional, unquantified benefits result from less fettling, a higher production rate and less sand disposal. With a new Landfill Tax, the latter point will become increasingly significant.

	Without filter (£)	**With** filter (£)	**Saving** (£)
Melting	4.23	2.43	1.80
Metal loss	1.58	0.91	0.67
Labour	6.42	4.46	1.96
Filter costs		0.81	(0.81)
	12.23	8.61	3.62

Table 2: Cost per casting

Westley Brothers plc

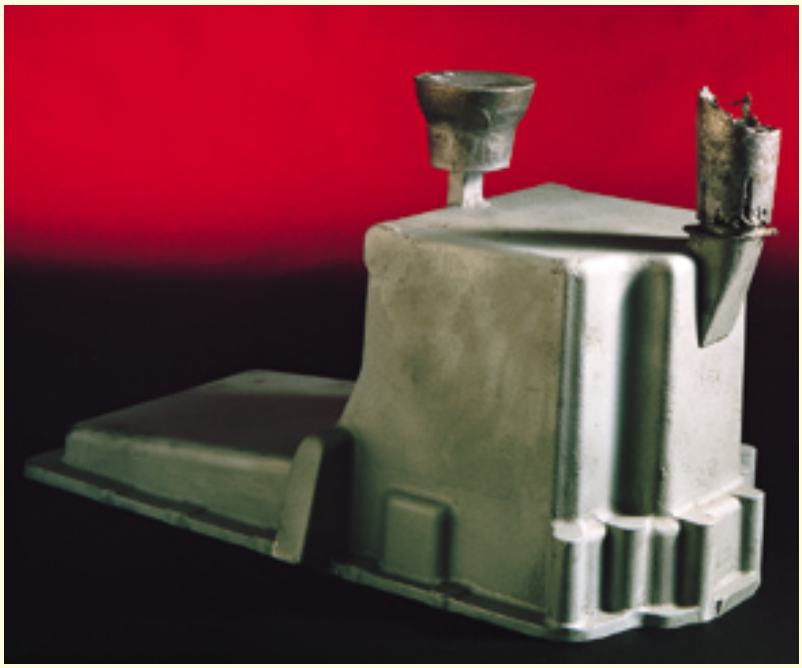
Westley Brothers plc operate a non-ferrous foundry primarily for the manufacture of castings in copper-base alloys, but some aluminium castings are also made. All melting is carried out in induction furnaces and castings are made in sand moulds and machined on the premises. Much of the work is manufactured to very high quality specifications. Material costs, including metal, tend to be high and the jobbing nature of the work results in high labour costs. Because of this, the foundry makes extensive use of foam filters to ensure optimum metal quality.



Pump casings made with and without filters

One example is in the manufacture of a 98.5 kg fettled weight pump casing in leaded gun metal, produced to BS 1400 LG2. The casing needs to be pressure tight and is tested to 24 bar. This is a heavily cored casting with the cost of cores and sand mould being significant. By using filters in the running system, the scrap and reject levels were reduced from 12% to under 4% resulting in savings of approximately £43 per casting. In addition, the appearance of the casting has been greatly improved, assisting marketing of the product.

Chiltern Castings



Side frame casting

Chiltern Castings is a small non-ferrous foundry using resin sand and gravity die casting methods to produce castings for a variety of industries. Most production is in aluminium.

Foam filters are used throughout the foundry, one example being in the manufacture of a 3.27 kg side frame in LM6M. The side frame was previously made with side runners and gates at each corner, but is now run through two filters directly on to the top of the casting. Considerable savings have been achieved including:

- Reduction in poured weight from 6.3 kg to 4.2 kg resulting in lower melting and metal loss costs;
- Dramatically reduced fettling;
- Reduction in the size of the mould resulting in less resin-bonded sand being required.

The savings are approximately £2.70 per casting, worth £3,000 per year.

R.D.U. Metal Treatment Station

The introduction of rotary degassing equipment over the last few years led to significant improvements in the degassing of aluminium alloys. The process proved consistent, environmentally superior to previous methods and improved productivity.
A further advancement with the process has now been made with the introduction of a combined rotary degasser and additive feeder - THE METAL TREATMENT STATION (M.T.S.).
The M.T.S. not only has all the advantages of rotary degassing but can at the same time feed granular flux, COVERAL GR, to clean the melt, improving mechanical properties and reducing oxide inclusions.
The equipment is robustly constructed, fully automatic and has a uniquely designed rotor system to ensure even dispersal of flux and trouble free operation.