Reduction of costs is the sole reason for the start of various programmes for waste sand reclamation. Regulations impose a reduction in the volume of dumped material, which means that disposal costs are continually rising.

Greensand moulding is a relatively simple, cost effective, energy and environmentally friendly process, which still makes it the most popular moulding process with approximate 70% of all the castings worldwide being produced in such moulds. The greensand is reused within the foundry on a continuous basis after the sand from the cast moulds is regenerated in the sand plant.

Overflow greensand (moulding sand) occurs at foundries with high core sand consumption, the input from the cores (made from new sand) imposing an overflow at the sand silos. This overflow sand is dumped as waste. Basically the name is wrong, it is not waste sand, there is just too much of it.

In general, this amount varies between 2% and 5%, depending on the refreshment rate and/or the amount of core sand per ton of liquid metal in the moulds. The popularity of the moulding process makes this relatively small percentage into a large volume in absolute figures. As a consequence, foundries are seeking ways to reuse this overflow sand. One such possibility is the Sand Cleaner reclamation system.

This presentation deals with De Globe’s experience with the reclaimed sand from the Sand Cleaner system, which is a cold mechanical grinding technique. The effects it has on the dumping volumes of the De Globe foundry are discussed and also its experience with the reuse of the dust extracted from the waste sand during the reclamation process.

When De Globe started sand reclamation in 1993, cores were produced containing 15% reclaimed sand. Now the cores contain on average 30% reclaimed sand, all being manufactured by the amine cold box process.

**CAUSES OF OVERFLOW SAND**

To prepare moulding sand in the most basic form, quartz sand is mixed with bentonite and water, for iron castings carbon is added to improve the appearance of the casting surface. When liquid metal is poured into this moulding sand, part of the bentonite is transformed into an oligic, non-active bentonite and a part of the carbon is burnt off. In the sand plant the appropriate amounts of new sand, carbon and bentonite are added, to compensate for these losses. This ‘refreshment’ sand is the cause of the overflow when only new sand is added to compensate for the decomposition of the bentonite and carbon.

When cores are required in the castings, this core sand enters the moulding sand system when the castings are taken from the mould after cooling. This ‘new sand’ also requires an addition of bentonite and carbon. If sufficient core sand enters the moulding sand system, foundries stop adding new sand for refreshment.

In both cases the amount of introduced new sand or core sand, including the bentonite and carbon, overfill the moulding sand system, therefore some needs to be removed. The target of any reclamation system is to make this overflow sand fit for reuse, either for refreshment sand or for core sand.

**THE SAND CLEANER SYSTEM**

The Sand Cleaner system from the Dutch company, Gemco Engineers BV, is a cold mechanical reclamation system that separates the quartz sand and the fines in the moulding sand. Additionally, it cleans the sand grains from its enveloping bentonite layer. A horizontally rotating grinding wheel is used to remove this hard oligic bentonite layer from the sand. Around the grinding wheel a slowly rotating paddle wheel transports the sand continuously on to the grinding wheel. The bentonite layer and other residual binders are ground off from the sand grains, no mechanical impact being used (fig 1). Above this a de-dusting unit extracts the dust and fines.

To be fit for processing, the waste sand must be dry in order to remove the bentonite from the sand grains. At De Globe a fluid bed drier takes the incoming waste sand from approximate 2% moisture down to below 0.2% moisture, the processed waste sand being stored in a ‘dried sand’ storage hopper.

**SAND RECLAMATION AT DE GLOBE**

At De Globe, the sand reclamation project was started with one objective, the prevention of sand spillage. One of the most important elements is to make the waste sand available for reclamation. This often requires investment in additional equipment or the introduction of new, or the redesign of the installation so that the waste sand from the system becomes available for reclamation.

De Globe started waste sand reclamation in 1993 with one Sand Cleaner, which gave a capacity of approximate 25 to 30 tonnes per day of reclaimed sand. In 1995 a second machine was added to the reclamation plant, this giving a total capacity of 60 tonnes per day. Also has been added a closed cooler for the castings, the core/greensand mixture from this cooler being available for reclamation.

This sand ends in the shot blaster where core lumps are blasted back to grain size. The sand from the shot blaster is de-ironed and sieved, going back to the waste sand silo for reclamation. This system
provides 45% of the sand for reclamation. The sand lumps from the polygon sieve are brought back to
grain size in a lump breaker before transfer to the reclamation system. In addition to this, scrap and
uncured cores are reduced to grain size in a separate lump breaker before transportation to the reclaimed
sand silo.

In 2000 90% of core sand was reused. On average
10% is added to account for all the losses in the
foundry, including loss of sand into the Sand Cleaner
system.

RECLAIMED SAND QUALITY CONTROL
Due to the variety of the sands reclaimed in the Sand
Cleaner, the system can only function properly if the
quality of the reclaimed sand is measured
continuously during the reclamation process.
For this purpose Gemco Engineers BV developed
and commissioned a separate (SPC) system, which
measures the quality of the reclaimed sand during the
grinding process and controls the grinding time
according to the required quality of the reclaimed
sand. In spite of all the variations of the incoming
waste sand, the reclaimed sand is stable in quality.

In order to understand more about the proportions
of the moulding sand in the De Globe foundry, it is
also important to know how much liquid metal is
poured into the green mould mould and how much core
sand is used per mould. This flow of sand and metal
in the foundry is indicated in fig 2. These figures are
the average sand and metal input per mould over the
year and can vary with the actual production.

De Globe uses on average 424 kg of core sand per
ton of liquid metal. In general, waste sand comprises
about 80% quartz sand grains and about 20% fines
(bentonite, coal dust etc). Out of 100% waste sand
some 70% is transferred as reclaimed sand from the
Sand Cleaner to the core shop sand silo. The degree of
efficiency of this (with regard to quartz) is about 88%
(fig 3).

This efficiency can be higher if the incoming waste
sand contains more core sand. In such cases it is easier
to clean the sand and the efficiency increases. De
Globe has an efficiency of the Sand Cleaner of
90%, because it also reclaim the sand from its shot
blaster - which contains mainly core sand. The
company reuses 78% of reclaimed sand in its cores,
with 12% broken scrap core sands, having to add 10%
new sand to compensate for sand losses.

The 5% dust from the extraction filter contains

Fig 2. Liquid iron vs Si02 ratio at De Globe.
sand. As already mentioned, reclamation is purely for the purpose of reducing costs; it is not worth setting out to achieve better values than those required.

The new sand added to the cores is only to compensate for the sand losses.¹

REDUCTION IN DUMPED VOLUMES

Foundries are continuously looking for ways to reduce the volumes dumped. The amount of waste materials per ton of good castings varies from foundry to foundry and type of casting. The waste mainly comprises slag from the melt plant, overflow moulding sand and some packing and waste material. For a foundry with heavily cored castings, the overflow sand is one of the most important factors of the foundry waste per ton of casting.

Any introduction of reclamation should start with a programme to prevent spillage, this being the cheapest and fastest way to achieve the highest savings. However for foundries with a high volume of overflow sand, this programme should be followed with a reclamation project.

Fig 4 indicates how the total amount of waste per ton of good casting was reduced over the years due to the introduction of the sand reclamation system. As can be seen, the reclamation system was introduced in 1993 and the capacity was gradually increased to the current output in 1997.

In 1991 there was 1,000kg of good casting per 1,000kg of waste material. In 2001 there was only 300kg of waste per 1,000kg of good castings - a saving of 700kg per ton. With the capacity of the foundry at 20,000 tons per year, the dumping volume has been reduced by 14,000 tons per year.

In the 300kg of waste material that goes out of the gate, 100kg of that is dust from the cyclone and 300kg of slag from the induction furnaces is re-used. As mentioned, this cyclone dust is re-used at the dump yard.

In reality only 70kg of non-re-useable (exothermal) lumps from the polygon sieve and the 100kg fines from the shot blasting finishing department are dumped.

REDUCTION IN FINNING

There is a constant risk of the finning defect in the De Globe foundry where heavy castings with intensive coring are produced. Often wood flour is added to the new sand and the cores are coated to avoid finning. Since the introduction of reclaimed sand from the Sand Cleaner, there has been a marked reduction in the occurrence of finning. The application of the coating and the addition of wood flour has decreased, and in many cases eliminated finning.¹

Tests have been carried out to ascertain the effect of finning between new sand and reclaimed sand. For this test, dome cores were cast in grey iron GG25 and in ductile GGG40. The results can be seen in Fig 5

This can be attributed to the remaining residual loss on ignition that is always present in the cold mechanical reclamation material. This residual loss on ignition (residual impurities) increases the plasticity of the cores and at the same time compensating more adequately for the expansion of the quartz grains.

IMPROVED MOULDING SAND PROPERTIES

When producing heavily cored castings, all the refreshment of the moulding sand is through the cores. This implies that after a period of time (say six months of operation) the whole moulding sand could consist of old core sand.

When used for moulding, the reclaimed can show some surprising changes. The first noticed was that more energy was required for mixing, an indication that, with the same equipment, the bentonite was being better developed and used more efficiently.¹

In the De Globe foundry a clear increase of higher wet tensile strength of the moulding sand was measured.

For IKO Erbslöth this was the start an investigation into the effect of the use of reclaimed greensand replacing the new sand addition on the moulding sand properties.¹ Reclaimed sand from three different foundries using the Sand Cleaner reclamation system was tested under laboratory conditions. The results showed a similar effect to that noticed in the daily practice of the foundries. The results are available in an IKO Erbslöth paper but in this paper the significant increase of 25% in green tensile strength is shown in Fig 6, and the effect on the sand flowability in Fig 7.

The increase in green tensile strength is attributed to the remaining bentonite on the reclaimed sand, which forms a perfect base for the adherence of new bentonite added during the sand re-generation. With the same mixing equipment, an increase in the quality of moulding sand could be achieved or as
CONCLUSIONS

The volume of dumped foundry waste sand and the purchase of new sand were reduced with the application of the Sand Cleaner. The dust from the dry bag filter is re-used in the moulding sand and saves on additives such as coal dust. The fines from the cyclone are being used locally. The use of reclaimed sand makes the foundry responsible for its own quality of the core sand. A reduction in fining on the castings has been noted, compared with castings made with new sand. The bentonite addition develops a better bond on reclaimed sand than on new sand. An increase in moulding sand properties has resulted in fewer scrap moulds and rejects in finished castings.

De Globe in Weert now produces only cores from reclaimed green sand and reclained greensand is preferred over new sand. The addition of about 10% of new sand is merely to make up for sand losses in the production system.

REFERENCES

Triple problem solving

Clayton Holdings has built upon the momentum created by its recent Open Day when its newly enlarged facility in Oldbury was opened by Digby Jones, director general of the Confederation of British Industry (see Foundry Trade Journal, August, 2001). It had a successful show at the recent Metals Engineering 2001 Exhibition at Birmingham’s National Exhibition Centre where new products for the foundry industry were launched. Included in the range on display was sand purification, de-core and heat treatment equipment from Clayton Thermal Processes.

LATERAL THINKING

The show also saw the launch of the company’s MPS (Multi Purpose System). This equipment is a lateral thinking approach to solving three major problems within the foundry industry. The enormous quantities of used sand wasted on a daily basis, plus the cost of replacement and dumping represent a severe strain on a company’s profitability as well as causing a significant impact on the environment.

De-coring of castings at present seems either to involve antiquated muffle type furnaces, where temperature control cannot always be accurate enough, or alternatively core removal by mechanical vibration - either by hand or dedicated equipment. This can result in damage to the casting and excessive noise with all its health and safety implications. Heat treatment may be necessary due to the alteration of desired properties or in some cases necessary to improve mechanical properties not achieved in the as cast condition.

SMALL FOOTPRINT

The Clayton MPS not only addresses all the above problems in sequence or individually but it will do so in a compact arrangement of equipment occupying a small single 'footprint'. Research and development within Beta Heat Treatment, the sub-contracting division of Clayton Holdings, has achieved this. This company is one of the UK’s experts in fluidised bed technology. It operates the largest capacity fluidised beds and services the motor, aerospace and Formula One racing industries.

Thirteen years of experience gained in the operation of fluidised beds has been used to develop a range of equipment so innovative, efficient and ergonomic that, the company says, all UK and European patents are being sought. Digby Jones, told fellow guests and employees at the companies Open Day, “Clayton Group companies represent the very best in British innovation”.

Clayton Thermal Processes Ltd, fax: (+44) 121 511 1192, e-mail: bp@claytonholdings.com, www.claytonholdings.com