



# The Green Foundry

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## ABSTRACT

The minimization of emissions, efficient raw material and energy usage, the recovery and recycling of waste and the substitution of harmful substances, are an important principles of the "Green foundry". The Swedish foundry industry has confronted themselves with the increasing demands of environmental protection, with low emissions and rinse of waste. In order to sustain an enduring foundry industry, a lot of innovative solutions have been obtained. This paper introduces a new greensand with low VOC- emission, created at SweCast AB and tested at Volvo Powertrain Corp., Sweden.

Keywords : Foundry, Environment, Greensand, VOC-reduction

## INTRODUCTION

The minimization of emissions, efficient raw material and energy usage, optimum process chemical utilization, the recovering and recycling of waste and the substitution of harmful substances are all important principles of the "Green Foundry". For foundries, the focal points are air emissions, the efficient use of raw materials and energy, and waste reduction, in conjunction with any recycling and re-use options.

## BAT – BEST AVAILABLE TECHNIQUE (BAT)

For a "Green Foundry" you have to use Best Available Technique (BAT). BAT is to optimize the management and control of internal flows, in order to prevent pollution. BAT is related to storage and handling, such as the storage of scrap on an impermeable surface with a drainage and collection system, the separate storage of incoming materials and residues, optimization of the metal yield.

Environmental considerations can be taken into account in the selection of the furnace type, induction vs cupola. Metal melting consumes 40-60% of the energy input of a foundry. Energy efficiency measures should therefore take both the melting and the other processes (e.g. air compression, plant actuation, hydraulics) into account. The need for furnace and off-gas cooling generates a hot water or hot air stream, which may allow an internal or external utilization of the heat.

BAT is for finishing techniques that generate dust and for heat treatment techniques. For abrasive cutting, shot blasting and fettling, BAT is to collect and treat the finishing off-gas using a wet or dry system. For heat treatment, BAT is to use clean energy (i.e. natural gas or electricity).

Concerning noise reduction, BAT is to develop and implement a noise reduction strategy, using enclosure systems for high-noise unit operations such as shake-out.

BAT for waste water management includes prevention, separation of the waste water types, maximizing internal recycling and applying an adequate treatment for each final flow. This includes techniques utilising e.g. oil interceptors, filtration or sedimentation.

For the reduction of VOCs and odour emissions from lost mould systems, water-based coatings and inorganic solvents may be considered. While water-based coatings are commonly used, the applicability of inorganic solvents in core-making is still limited.

Since foundries make intensive use of sand as an inert primary material, the regeneration or re-use of this sand is an important point of consideration as part of its environmental performance. Various techniques are applied for regeneration of the sand (i.e. treatment and internal re-use as moulding sand), the selection of which depends on the binder type and the sand flow composition. If sand is not regenerated, then external re-use may be considered in order to prevent the need for its disposal. Its application in various areas has been demonstrated in a large Nordic project "CASCADE" ([www.nordicinnovation.net](http://www.nordicinnovation.net)).

The following experiments were carried out:

- Composting of bark and fibre from the forestry industry (Sweden). This involved using bentonite-bonded sand, ester-cured phenol resin sand, crushed scrap cold box cores and dust from furane sand reclamation.
- Composting of food industry and domestic waste (Finland), using bentonite-bonded sand/dust and ester-cured phenol resin sand/dust.
- Composting of wastewater treatment sludge and garden and park waste (Denmark), using bentonite-bonded sand/dust and furane sand/dust.
- Use of furane sand in growing mixtures (Norway),

The advantages of composting are:

- Organic contaminants are reduced.
- Sands are effectively mixed.
- Good oxygenation.
- Materials are store before being used in final soil production.

The disadvantages are:

- Increased handling costs.
- Increased environmental pollution from the operation of machines.
- Difficulty in achieving very accurate proportioning of materials in the final soil product.

BAT is to implement and adhere to an Environmental Management System.

More about BAT in foundries can be read in EU reference document (ref. 2).

### GREEN GREENSAND – NAYVOC®

SweCast AB/Swedish Foundry Association has long placed a high priority on issues of sustainable development in connection with the casting process. One result has been the development of NAYVOC®, a substitute for coal dust in close cooperation with Volvo Powertrain Corp. in Skövde, Sweden.

One problem that arises when attempting to find an inorganic substitute for coal dust, for example, is an increased risk of sand sticking – the problem of sand clinging to the casting when it is removed from the mould causing increased wear on blasting equipment and increased loss of moulding sand.

A comparison of the results when bentonite is heated to 1200°C for 10 minutes with two alternative mixtures: coal power vs. NAYVOC® was made. Both additives delay the sintering of bentonite, which results in less sand sticking to the casting during knock out. This has been confirmed both with small-scale test runs and with full-scale trials on Volvo's production line in 2007.

### TEST RUNS AND FULL-SCALE TRIALS

Castings made at SweCast's test foundry in Jönköping have found that total VOC emissions are reduced by up to 90%, with no reduction in the quality of knock-out characteristics.

It should be noted that VOCs are also emitted by core binding agents. The test runs have been conducted with the production of solid brake discs (without cores), while the full-scale trials involved both solid and ventilated brake discs (cold box cores).

Total VOC emissions, including methane, were measured with a flame ionization detector (FID-instrument).

The results of measurements taken from castings of a single solid brake disc resulted in three of the moulds comprising virgin materials, the fourth batch of moulding sand was previously used at a foundry. The time scale was 60 minutes, the mould was opened after 40 minutes.

After the positive results of the smaller-scale test runs, a full-scale trial was conducted on one of the production lines at the Volvo foundry in Skövde.

The castings produced were mainly ventilated and solid brake discs, with the entire moulding sand system being replaced every third or fourth day.

Normally, 100% conventional coal dust is used. But as an additional safety measure, the first trials used a mixture of 60% conventional coal dust and 40% NAYVOC®. The trial period



Fig. 1 : Conventional method for green sand



Fig. 2 : New method for green sand

with this mixture continued for one week, followed by a return to 100% conventional coal dust. After a thorough analysis of the castings, sand properties and emissions, a more extensive four-week trial was conducted, again with a 60/40 mixture of coal dust and the new additive, NAYVOC®.

All parameters and set points relating to moulding sand properties were held constant during the trials. The only difference between the trials and normal operation was that the silo was filled with a 60/40 mixture of coal dust/NAYVOC® instead of 100% coal dust.

Total VOC was continuously measured with a flame ionization detector throughout the trial periods, and selected hydrocarbons were measured in random samples collected with TENAX absorbers.

Thus far, the results indicate that:

- Using a 60/40 mixture of coal dust/NAYVOC®, total VOC emissions are reduced by some 35%.
- Emissions of benzene are also sharply reduced; the results of the first trials indicate a reduction of around 45%.
- No negative effects have been observed for either casting quality or moulding sand properties.



Based on these positive results, it is expected that commercial production of NAYVOC® will commence toward the beginning of 2008. The first fullscale application will be in the mid of 2008.

## CONCLUSIONS

A substitute for coal dust has been created at SweCast, Sweden. NAYVOC® reduces the emission of VOC, benzene etc.

A “Green foundry” have to work continuously with BAT. In Europe at CAEF, Commission 3, R&D, we are planning a large EU-project “The Green Foundry” to evaluate and create better and better technique for a good environment.

## REFERENCES

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