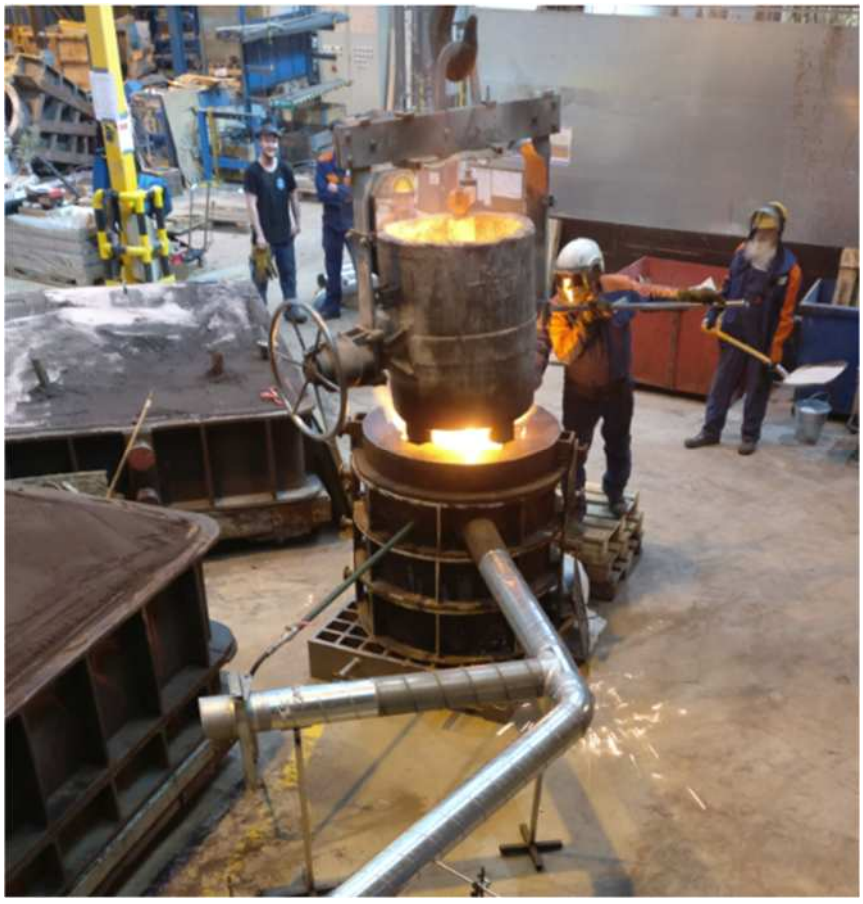
AX-Consulting

Green Foundry LIFE project (LIFE17 ENV/FI/173)

Action B1 Emissions of different binder systems during small-scale test casts

De.B1A Results of emission measurements of inorganic binder system chamber test cast in Karhula foundry in Finland



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Client	Karhula Foundry Ltd. Pajatie 91 FI-48600 Kotka Finland
Assignment	Measurement of emissions from the casting mold
Measurement date and place	Kotka, April 25th 2019
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1 Introduction

Karhula Foundry Oy is ferrous foundry that produces demanding cast components for process industry, mining, marine, energy and general engineering. The production began at Karhula in 1880's. The melting capacity consists of 8 tons arc furnace and 8 tons, 1,5 ton and 0,5 ton induction furnaces. Karhula Foundry has an 8 tons AOD (Argon Oxygen Decarburization) converter for metal treatment. Karhula Foundry produces high alloyed steels such as duplex, martensite, ferritic and austenitic stainless steel, super-austenitic steel, heat, wear and corrosion resistant steels and low alloyed steel.
Karhula Foundry produces also ductile iron, ADI iron (Austempered Ductile Iron) and special alloyed iron. Typical products are pumps and valves, coilers, gear wheels, segments castings. The binder system for moulds is Alphaset. The cores are made by using Alphaset, Betaset or Cold-Box binder systems. All the methods are based on phenolic resin binders.
The sand used for moulds and cores is high quality silica sand. Some chromite sand is used for the surface part of moulds, when an excellent heat resistance is needed.
The painting of the moulds and cores is made by zircon-based coatings.
The weight range of the castings is between 1 kg to 30 tons.
Karhula Foundry has two mechanical moulding lines for small and medium size castings and a hand moulding for the bigger moulds.
The pouring of the metal into moulds is made from pre-heated ladles.
Cooled moulds are shaken out by vibration. The feeders are removed by cutter, arc-air or powder cutting methods. The surfaces of the castings are refined by steel shot blasting.
Annual production capacity is 3500 tons of steel castings, but the production in recent years has been 2000..3000 tons. The foundry has about 80 employees.

Emission measurements of casting mold with an inorganic binder system were carried out in Karhula Foundry Ltd on 25.4.2019. The aim of the measurements was to find out the concentration of components, emissions and mold temperatures during the casting process. During normal casting process, it is not possible to measure released total emission concentrations, so test casting was carried out with special test arrangements.

2 Conclusions

The steel test cast was 200 kg and the sand amount was 210 kg. In this test arrangement the inorganic binder system was tested. Measurement arrangement was structurally same as at URV foundry. Because of the measurement arrangements, the exhaust gas coming to analyzer had to be diluted. Results are presented with using the dilution factor. However, it has to be noticed that the dilution air was taken from the same casting hall, to where the exhaust gas from the test casting was extracted. There

was also background concentrations in the hall, because it was inside the factory.

During the measurement the exhaust air flow rate was about 60 l/s. The melt was poured to the test cast at 11:10 and total emission measurements continued until 17:15.

Based on the results of the chamber test carried out with a steel test cast and using inorganic binder system the total emission measurements demonstrated very small emission concentration. Highest concentrations were measured from carbon monoxide (0,13 mg/ton casting) which was very small compared to results when using organic binders (CO average 9,55 mg/to casting). All measurement results are presented in this report.

2.1 Carbon monoxide (CO)

Results show that there was a short-term high concentration of CO when the melt was poured and afterwards the concentrations started to reduce rapidly. CO has the highest concentration, especially during melt was poured.

2.2 Volatile Organic Compounds (VOC)

During the melt was poured, there was also small peak in the concentration of the VOC compounds. Soon after melt was poured VOC concentration decreased. Because the mould was warming up and different compounds have different evaporating temperature, VOC concentration is not going down as linearly than other measured gaseous components.

2.3 Sulphur dioxide (SO_2) and nitrogen oxides (NO_x)

During the measurements no significant concentrations of sulphur dioxide or nitrogen oxides were detected.

2.4 Oxygen (O_2) and carbon dioxide (CO_2)

Oxygen concentration was decreasing for a while the melt was poured from 20.9% to 13.5%. At the same time there was a small amount of carbon dioxide present. Concentrations decreased slowly to the level of normal air concentrations.

2.5 Particles

Particle concentration was also measured from the exhaust air. The average concentration was around 7,7 mg/Nm^3.