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THE USE OF GAS CHROMATOGRAPHY IN PYROLYSIS OF FOUNDRY BINDERS

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1. Introduction

Foundry engineering belongs to an industrial branch of an increased professional risk. During the whole casting production process employees are exposed to dangerous, harmful and uncomfortable factors related, among others, to emissions of harmful substances. One of the reasons of such emission are binding agents applied in foundry practice and hardeners undergoing thermal decomposition at high temperatures. Due to this, several more of less harmful organic compounds are formed. In dependence on the applied resin, under a temperature influence can be formed and released such compounds as BTEX group [1-3].
Gas chromatography is one of the useful techniques for the analysis of compounds from the group BTEX. The aim of this study was the determination the temperature influence on formation substances from the BTEX group, during thermal decomposition of the fresh moulding sand with furan resin. The analysis was carried out by the gas chromatography method with the application of the GC Trace Ultra (Fig. 1) with flame-ionising detector (FID) [4-7].

Fig. 1. Gas chromatography GC Trace Ultra with FID detector (Thermo Scientific) [7]

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2. Experimental

The aim of investigations was the determination of emission the compounds from BTEX group in temperature 500 and 1350°C from fresh moulding sand with furfuryl resins. Moulding sand came from the iron foundry. The following moulding sands were tested:

- M1 – matrix: 15 % fresh high-silica sand, 85 % reclaim, binder: 1 % resin, 0,5 % hardener – in relation to the moulding sand amount (H/R[2] = 0,50);
- M2 – matrix: 15 % fresh high-silica sand, 85 % reclaim, binder: 0,9 % resin, 0,45 % hardener – in relation to the moulding sand amount (H/R = 0,45);
- M3 – matrix: 100 % fresh high-silica sand, binder: 1 % resin, 0,4 % hardener - in relation to the moulding sand amount (H/R = 0,40).

The analysis of substances from BTEX group were carried out by the gas chromatography method with the application of the flame-ionising detector (FID). The identification was carried out by means of the system consisting of the gas chromatograph Trace GC Ultra, equipped with the capillary chromatographic column RTX 5MS (Restek) of a length 30 m and internal diameter 0,25 mm.

3. Results and discussion

Quantitative data of the emissivity of components from the BTEX group are listed in Table 1 and 2.

Table 1. Results of the BTEX content emitted from the moulding sands during the thermal decomposition (500ºC)

Sample	BTEX content in emitted gases [mg/kg moulding sand]			
	B	T	E	X
M1	0,00*	18,78	0,053	0,00*
M2	0,00*	17,65	0,074	0,00*
M3	0,00*	9,65	0,028	0,00*

* below the limit of quantification

Table 2. Results of the BTEX content emitted from the moulding sands during the thermal decomposition (1350ºC)

Sample	BTEX content in emitted gases [mg/kg moulding sand]			
	B	T	E	X
M1	296,01	2,83	0,552	0,014
M2	333,14	2,51	0,621	0,022
M3	170,81	1,45	0,318	0,010

4. Conclusions

As the result of the performed investigations, several conclusions, related to the thermal destruction of moulding sands, can be drawn. Moulding sands on the matrix with a reclaim addition exhibit higher benzene emission than moulding sands on the fresh high-silica sand ma-

[2] H/R : hardener to resin ratio

trix. The moulding sand hardening degree (it means the H/R ratio) and the temperature, has an influence on the BTEX emission.

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