Performances of green and eco-friendly ramming pastes in EGA pots

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Abstract

Consistent and high quality ramming paste products, installed according to optimised procedures, are required for improved operation and longer pot life. However, ramming paste used to be a hazardous product and needed special precautions for handling and application. A 100 % eco-friendly cold ramming paste has been developed by Carbone Savoie and tested at Emirates Global Aluminium (EGA) sites. A test has also been developed by Carbone Savoie to follow-up, identify and quantify emissions during the baking of paste up to 1 000 °C. Physico-chemical characteristics of various pastes are presented, together with their composition in polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds (VOC), determined by an accredited laboratory and the results of emissions during paste baking. The results of pot operation at the EGA sites show no harmful impact on pot preheat, early operation or regular operation performance. Pot performance data are given for comparison. Th new paste offers a green and clean alternative to harsh chemicals typically associated with the industry.

Keywords: Ramming paste; eco-friendly cold ramming paste; PAH; characteristics; pot performances;

1. Introduction

Ramming paste plays an important role in the pot, ensuring pot tightness regarding metal infiltration at the block/paste interface. The installation of ramming paste is a heavy operation that could lead to technical and quality issues, as well as health, safety and environmental issues. In recent years, ramming paste producers have developed eco-friendly (EF) products to reduce PAH content and Carbone Savoie has been the first to introduce a 100 % clean paste, which has been used at EGA sites. A test has also been developed by Carbone Savoie to follow-up, identify and quantify emissions during the baking of paste up to 1 000 °C.

Several pastes used at EGA's sites were fully characterised to obtain their physico-chemical properties, as well as their composition in PAH and VOC, and their emissions during baking. The results of pot operation at the EGA sites are also presented.

2. Ramming pastes presentation

Five types of ramming pastes have been studied, labelled A, B, C, D and E. They are either 100 % anthracitic pastes or semi-graphitic, and are based on various types of binder, which affects the PAH content of the paste and the emissions during baking. The range of working temperature of the pastes is indicated in Table 1, together with their expiry date. Paste B is NeO^2 and paste E is $CleO^2$ of Carbone Savoie.

Table 1. Working temperature range and expiry dates of the five pastes studied.

Sample ID	A	B	C	D	E
T range (°C)	20 to 40	10 to 50	17 to 42	20 to 40	10 to 50
Expiry date	End of Sept'2015	End of July'2015	End of Jan'2016	End of July'2015	End of Mar'2016

2.1. Chemical composition

The five pastes were sent to an accredited external laboratory to evaluate their chemical composition in terms of PAH and VOC. A list of 50 VOCs could be analysed. The PAH extracted were analysed by gas chromatography associated with a mass-spectrometer. Table 2 gives the results for 17 PAH, the most commonly measured; together with BTEX and VOC. For VOC, only the species detected at least in one of the pastes, are listed.

Table 2. PAH, BTEX and VOC composition of the pastes in mg/kg.

Pastes	A	B	C	D	E
Component (mg/kg)					
Fluoranthene	1529	< 10	1817	1255	< 10
Benzo(b,j)fluoranthene	54.1	< 10	37.2	1745	< 10
Benzo(k)fluoranthene	16.7	< 10	11.2	392	< 10
Benzo(a)pyrene	**59.1**	**< 10**	**38.4**	**1373**	**< 10**
Indeno-pyrene	69.2	< 10	53.8	459	< 10
Benzo(g,h,i)perylene	143	< 10	88.5	1294	< 10
Naphtalene	663	< 10	492	14137	< 10
Acenaphtene	13394	< 10	16481	13196	< 10
Fluorene	7798	< 10	12327	2863	< 10
Phenantrene	4683	< 10	5587	882	< 10
Pyrene	808	< 10	1087	1088	< 10
Benzo(a)anthracene	51.6	< 10	59.7	892	< 10
Chrysene	45.7	< 10	54.9	1088	< 10
Acenaphtylene	< 10	< 10	12.9	31.7	< 10
Dibenzo(a,h)anthracene	21.5	< 10	18.3	190	< 10
Anthracene	541	< 10	554	155	< 10
BbNT	< 10	< 10	10.1	122	< 10
PAH total	**29 877**	**-**	**38 730**	**41 163**	**-**
Benzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	< 0.05	< 0.05	0.23	< 0.05	< 0.05
Ethylbenzene	0.15	< 0.05	0.55	0.21	< 0.05
Xylene	0.19	< 0.10	0.54	0.61	< 0.10
BTEX total	**0.34**	**-**	**0.78**	**0.82**	**-**
dichloromethane	0.38	0.31	0.37	0.4	0.32
trimethyl-1,2,4 benzene	0.07	< 0.05	0.1	0.68	< 0.05
trimethyl-1,3,5 benzene	0.1	< 0.05	0.18	1.1	< 0.05
n-butyl benzene	0.14	< 0.05	0.2	0.26	< 0.05
cumene	< 0.05	< 0.05	0.1	0.08	< 0.05
n-propyl benzene	< 0.05	< 0.05	0.06	< 0.05	< 0.05
styrene	< 0.25	< 0.25	< 0.25	0.28	< 0.25
cymene	< 0.05	< 0.05	< 0.05	0.1	< 0.05

For pastes B and E, neither PAH nor BTEX could be measured. Only dichloromethane could be detected, as in all pastes. Dichloromethane is the usual solvent for chemical analyses and these values could correspond to some pollution in the analytical equipment.

Pastes A and C present a rather similar PAH and BTEX profile, with a high amount of acenaphtene, fluorene and phenantrene (by descending order). Paste D presents the highest level of PAH and BTEX, and also by far the highest level of Benzo(a)pyrene (BaP). The level of BaP shows clearly that

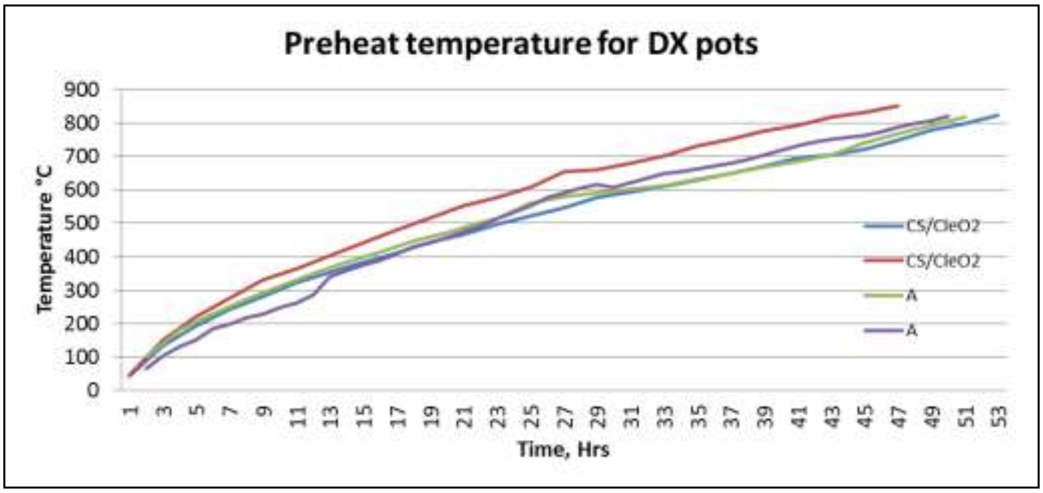

Figure 15. Preheat temperature for DX pots with different pastes.

6. Conclusions

Various ramming pastes, including eco-friendly (EF) and 100 % clean pastes, have been analysed. Their chemical and physical properties show some differences between pastes. A test to monitor the emissions during baking of the pastes has been developed and the results are presented. The performance of these new types of clean pastes in EGA pots is good and does not differ from other pastes.

7. References

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