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REMOVAL OF PLATINUM GROUP METALS (PGMs) FROM THE SPENT AUTOMOBILE CATALYST BY THE PYROMETALLURGICAL PROCESS

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ABSTRACT
Due to the constantly decreasing of the metals content in ore deposits in the world, the general world trend is metals obtaining from secondary raw materials. Because of that spent automobile catalysts are satisfactory secondary raw materials for platinum group metals. Recycling of platinum group metals from the used automobile catalyst is profitable from ecological and also economical point of view. Review of worldwide existing methods for spent automobile catalyst processing (hydro-metallurgical and pyrometallurgical) with special reference to the pyrometallurgical processing invented in the Institute for Mining and Metallurgy Bor, with recovery of PGMs over 98% will be presented in this paper. The results show that the applied procedure of pyrometallurgical processing of automobile catalysts could be used to obtain PGMs.
Keywords: spent automobile catalyst, platinum group metals, pyrometallurgy

1. INTRODUCTION
Platinum group metals (Pt, Pd, Rh) are used in auto catalytic converters due to their remarkable resistance to high temperature corrosion and oxidation. The quantity of platinum, palladium and rhodium used in auto catalysts may vary greatly by vehicle type, manufacturer, year and additional factors. For example depending on the engine capacity the auto catalytic converters can contain about 2 g platinum, 0.5 g rhodium and less than 0.5 g palladium per kg of catalytic converter.
Due to scarcity and high value of PGMs there is an increasing interest towards their recovery from wastes, such as spent automobile catalyst, with economic and environmental consequences [1]. Recycling spent automotive catalysts to recover their PGMs has received much attention in recent years [2,3]. In the typical PGMs recovery process, PGMs are extracted from scraps by smelting them with collector metals such as copper, or dissolving the scraps in strong acids [4]. The extraction methods can be classified in three groups: hydrometallurgical, volatilization and pyrometallurgical methods. The method we have proposed belongs to the pyrometallurgical methods group.
The aim of this work was to recover platinum group metals from spent automobile catalyst by the application of pyrometallurgical exctraction method.

2. EXPERIMENTAL
In the Institute for Mining and Metallurgy Bor has been performed a semi-industrial processing of spent automobile catalyst. After extensive laboratory testing in order to find the most appropriate ways for their treatment, combined processing procedure was used, consisting of pyrometallurgical treatment, and electrolytic refining. The final products are high purity copper cathode (99.99 %) and

platinum metals (Pt, Pd and Rh) of equivalent purity. If, necessary, the final products can be a precious metal alloys.

2.1 Pyrometallurgical processing of spent automobile catalyst

Technological process is proposed for the treatment of spent automobile catalyst combinig pyrometallurgical treatment, and electrolytic refining. Block diagram is shown in fig. 1. The first stage in the processing of spent automobile catalyst is their preparation. This stage consists of crushing and milling, homogenization (which includes mixing of spent automobile catalyst and fluxes in a certain ratio), pelletizing and drying the obtained pellets.

Melting has been performed in electric arc furnace (BIRLEC, maximum power 200kW) shown in Fig. 1. Pre-dried pellets are poured to the pre-melted copper which acts as a collector metal. Melting is carried out periodically by pouring slag out of the furnace which are later transported to the dump. The slag, if the process is properly carried out, poor in copper and precious metals (approximatly < 0.2 % of copper in slag). Platinum metals are due to its high affinity of copper collected in copper. After outpouring the slag from the furnace, the casting of copper anodes were performed. Casting is performed in steel molds. Cast anodes contain about 1% of precious metals. After cooling, the anodes goes to the electrolytical process, where cathode copper and anode sludge is obtained. Anode sludge contains approximately 20-25 % of platinum metals.

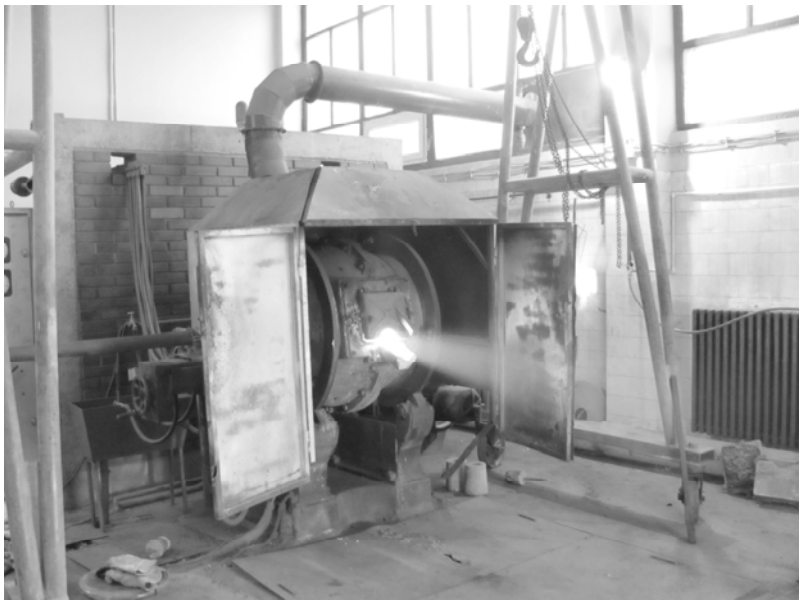

Figure 1. BIRLEC furnace for melting spent automobile catalyst

3. RESULTS AND DISCUSSION

Technological process is proposed for the treatment of spent automobile catalyst combining pyrometallurgical treatment and electrolytic refining. Block diagram is shown in Figure 2.

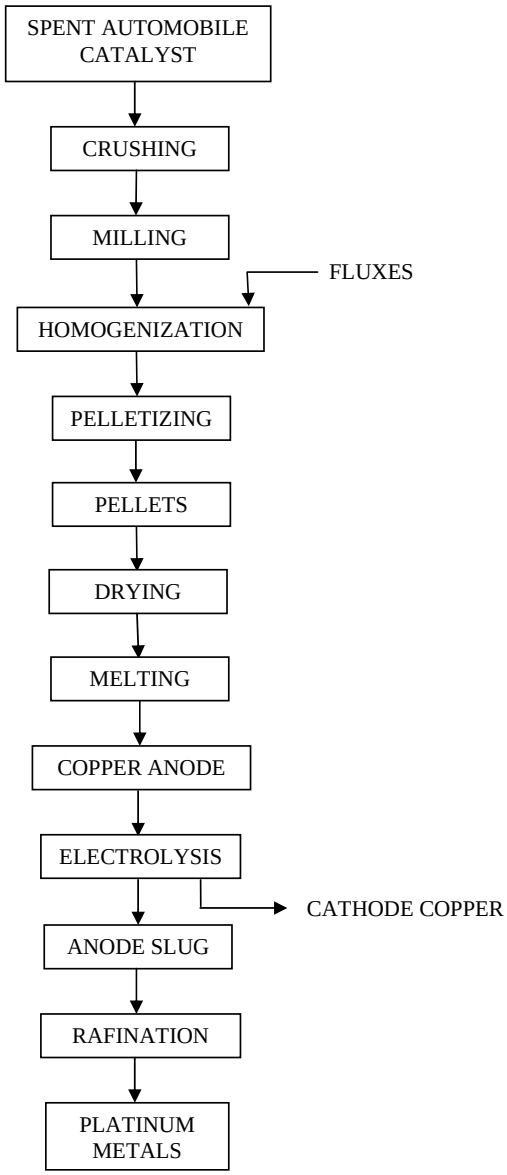

Figure 2. Block diagram of proposed technological process for the treatment of spent automobile catalyst

The proposed technological process consists of several stages and represents the basic processes and operations that would be used in order to obtain high purity copper cathode (99.99 %) and platinum metals (Pt, Pd and Rh) of equivalent purity.

4. CONCLUSION

The recycling of spent automobile catalyst is crucial in order to economise on valuable resources and to minimise the environmental pollution connected with PGMs production. The results presented in this paper shows that the proposed technological process for treatment of spent automobile catalyst

provide high technological efficiency of copper and platinum group metals (mainly Pt and Pd) and high production capacity. The high recovery of the platinum group metals from the spent automobile converters supposes an important advance to reduce extraction rate of platinum, palladium and rhodium and allows the performance of one of the premise of the sustainable development.

5. ACKNOWLEDGEMENTS

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