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ANALYSIS OF PLATINUM CONTENT IN USED AUTO CATALYTIC CONVERTER CARRIERS AND THE POSSIBILITY OF ITS RECOVERY

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At present, every launched car must be equipped with a catalytic converter, in which the precious metals such as platinum, palladium and rhodium play catalytic role. Catalytic converters have a limited life time, therefore they have to be replaced and become a valuable source of platinum group metals (PGM). Currently in the world, used auto catalytic converters are processed in pyrometallurgical or hydrometallurgical way. However, the first step of such treatment should be a chemical analysis. In the paper catalytic carriers were analysed taking into account the level of platinum. Scanning electron microscope was used. The analysis concentrated on testing samples coming from different catalytic carriers. The structure of tested samples, chemical analysis and X-ray energy spectra (EDS) where presented as well as the discussion of obtained results and possible methods of platinum recovery.

Keywords: used auto catalytic converter, platinum content in catalytic converters, methods of platinum recovery

Obecnie każdy wyprodukowany samochód musi być wyposażony w katalizator, w którym metale szlachetne takie jak platyna, pallad czy rod pełnią funkcje katalityczne. Czas życia katalizatorów jest ograniczony, zatem zostają one zastąpione nowymi, a stare stanowią ważne źródło platynowców. Zużyte katalizatory samochodowe przerabiane są hydrometalurgicznie lub pirometalurgicznie. Jednakże pierwszym etapem takiego przerobu powinna być analiza chemiczna. W pracy analizie na zawartość platyny poddano kilka różnych nośników katalitycznych pochodzących z różnych samochodów. Do tego celu posłużył elektronowy mikroskop skaningowy. Przedstawiono strukturę analizowanych nośników katalitycznych, ich analizę chemiczną jak również wykresy EDS (Energy Dispersive Spectrum). Przeprowadzono dyskusję wyników i możliwych metod odzysku platyny.

1. Introduction

There are millions of cars on the road all over the world, and each one is a source of air pollution. In order to fulfill the European Standard and Directive 94/12/EEC, on ambient air quality, all the motor vehicles produced since 1993 must be fitted with catalytic converters [1]. Auto catalytic converter installed in a car reduces emission of carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxide (NO_x) below the legislated levels. They are converted into harmless nitrogen, carbon dioxide and water.

Today there are many types of catalytic converters. Cars with petrol engine usually use Three Way Catalyst (TWC), whereas cars with Diesel engine use Diesel Oxidation Catalyst (DOC), Diesel Particulate Filters – DPF and NO_x adsorber catalyst (NAC). TABLE 1 presents short characteristics of different types of catalytic converters.

Fig. 1 presents an example of TWC catalytic converters – metallic and ceramic carrier with different shape for petrol and Diesel engine and also DPF filter. Catalytic converters are generally built from metallic or ceramic carrier with porous structure of honeycomb, covered by the layer of PGM (Platinum Group Metals) such as platinum, palladium and rhodium. The most frequently applied are mixtures of platinum and rhodium in ratio 5:1 or palladium and rhodium in ratio 7:1. Particles of PGM metals are no higher than 50 nm (the better level of substance dispersion the better efficiency of catalytic converters). The contents of PGM metal especially platinum in catalytic converters differs slightly. It depends on the application of catalytic converters and the manufacturer. TABLE 2 presents prices of chosen used catalytic converters coming from different types of cars. The price of used auto catalytic converter is determined by many factors, which can change from day to day. To these factors belong: technical state of given types of catalytic converter, the changing prices of PGM metals and also exchange rate. There are also differences in prices and the mass of catalytic converters used by the same manufacture but in different car models. TABLE 3 presents the prices of catalytic converters used in BMW and VW. The strict rules for the purity of fumes emitted to the atmosphere cause the quick evaluation of catalytic converters. More and more systems of few catalytic converters are applied.

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This can especially be seen in the new generation cars with compression-ignition engine, where apart from standard catalytic converters also the filter of solid particle FAP is installed (to remove particles of carbon black from the fumes).

TABLE 1
Short characteristics of catalytic converters applied in many cars [2-6]

Type	Characteristics	Efficiency
TWC	Three Way Catalyst gives possibility to reduce NO_x and in the same time oxidize CO and HC; it consists of: • steel shell resistant to corrosion and high temperature • ceramic or metallic monolithic carrier made from ceramic materials with different sections (oval, circular or flattened), it has many tiny channels separated by thin walls • intermediate layer with carrier prime (alumina) and promotors (addition of cerium oxygen to increase this layer resistance for ageing) • active layer i.e. catalytic substance which is a mixture of platinum group metals (Pt, Rh, Pd, Ru and Ir)	removal CO (90-99%), HC (50-90%), NO_x (90-99%), CH_2O (80-95%), dangerous compounds (80-95%)
DOC	Diesel Oxidation Catalyst is a very efficient tool to control the level of carbon monoxides, hydrocarbons, and compounds responsible for odour and organic volatile fractions, the main disadvantage of this reactor is low reduction of nitrogen oxides	removal CO (70-95%), HC (70-90%), aldehydes (70-90%), solid particles (10-40%)
DPF	Diesel Particulate Filter is used to remove solid particles; its construction is similar to TWC catalytic converter with one difference, one of two channels is blind, walls of both channels are made from SiC covered by alumina on which platinum is placed; exhaust gases can penetrate between channels due to porous structure of filter, as a result solid particles are captured in walls and at the bottom of the blind channels	removal CO (90%), HC (60-80%), solid particles (70-95%)
NAC	NO_x adsorber catalyst collects NO_x in oxygen excess in the ratio air/fuel and releases catalytically reduced formely collected NO_x in fuel excess in the ratio air/fuel (in this condition PGM metals are capable to quick reduction of NO_x to N_2)	removal NO_x

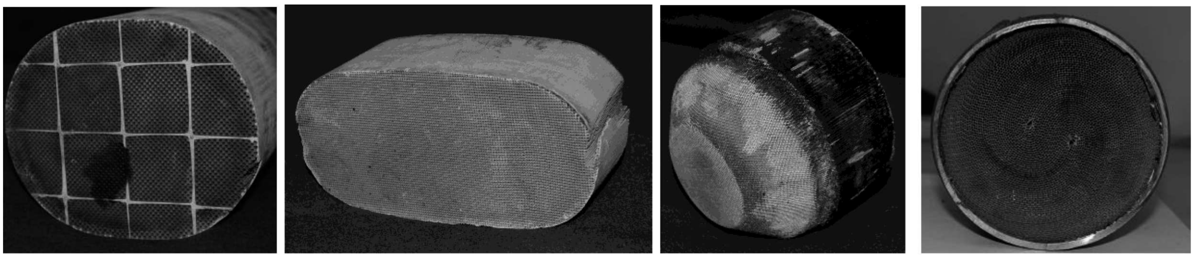
TABLE 2
Prices of chosen used catalytic converters coming from different types of cars [7-9]

Car	Mass	Price, PLN	Car	Mass	Price, PLN
Alfa Romeo	1.74	430-470	Mercedes	1.37	1520
Audi A8	2.82	1020-1050	Nissan	3.09	260
Chrysler	1.53	1540-2000	Opel Astra	0.80	300
BMW	1.71	750-840	Opel Insignia	3.2	900
Daewoo Matiz	0.40	50	Peugeot 307 hdi	1.7	1000
Fiat Ducato	1.6	410	Renault Clio	0.9	170
Ford Focus	1.4	180	Saab	0.92	490
Honda Accord	1.3	250	Suzuki	2.97	780
Jaguar	1.51	1100	Toyota Avensis	0.9	200
Mazda	3.06	1240	VW Passat	1.3	240

Modern and well exploited catalytic converters can be used for more than 80 000 km. However, the lifetime of catalytic converters is limited; converters should be periodically regenerated and after some working time, changed. Therefore, more and more used auto catalytic converters go to the scrap disposal sites. Today all disposed catalytic carriers are treated metallurgically in order to recover especially platinum, but other precious metals as well. It should be mentioned that recovery process of precious and other metals is very beneficial because it limits the amount of disposed wastes, saves the natural resources and limits the energy consumption. Additionally, pollution emitted during recovery of metals from wastes is lower than during their production from primary raw material. Recovery of platinum group metals from used catalytic converters has slightly increased in the last ten years, but is still not sufficient [10].

TABLE 3
Prices of catalytic converters taking into account the mass of converter carrier in two different cars (BMW and VW) [7-9]

Car	Mass, kg	Price, PLN	Car	Mass, kg	Price, PLN
BMW	1.71	max. 840	VW	2.29	max. 1010
	1.05	max. 870		3.00	max. 1370
	4.23	max. 640		3.47	max. 1100
	1.74	max. 560		1.46	max. 930
	2.28	max. 1080		3.80	max. 1050
	1.45	max. 500		4.05	max. 970



a) b) c) d)

Fig. 1. View of different catalytic converter carriers: a) DPF, b) TWC – ceramic carrier used in cars with petrol engine, c) TWC – ceramic carrier used in cars with Diesel engine, d) TWC – metallic carrier

2. Methodology

The first step to recover PGM metals and especially platinum from used auto catalytic converters is to collect and then dismantle them. There are many methods of platinum recovery, so the next step should be chemical analysis in order to determine the level of platinum in these carriers. Some carriers contain high level of platinum; they can be used as a complete unit. These carriers which contain medium or small platinum can be milled and also homogenized. After this operation chemical analysis is done to check the level of platinum and other precious metals. If platinum level is lower than 30%, the thickening operation is applied.

For the purpose of this analysis six different catalytic carriers were under study. The research of catalytic carrier surface was done with the use of Hitachi S-402 scanning electron microscope (SEM) equipped with X radiation detector. Accelerating voltage applied during observation and X-ray analysis was 15 kV. Microanalysis of chemical composition of every catalytic carrier sample was done using EDS (Energy Dispersive Spectrum).

3. Results of the research

First two samples (No 1 and No 2), which were taken for analysis, came from catalytic converter carriers applied in cars with Diesel engine. Fig. 2 and 3 show the structure of tested samples with marked selected areas for X-ray energy spectra. TABLE 4 presents the chemical analysis for areas marked in Fig. 2 and Fig. 3, whereas Fig. 4 and 5 show the X-ray energy spectra (EDS) from selected areas for sample No 1 and 2 respectively. The content of platinum is high in both samples, especially in the second one (reaching 31.7%). It means that in order to recover platinum these catalytic converters should be used as a complete unit.

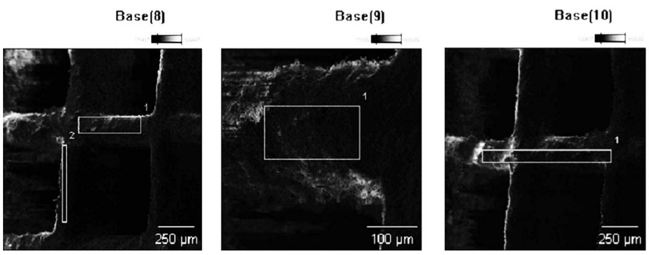


Fig. 2. Structure of tested sample No 1 of catalytic converter carrier coming from Diesel engine car with marked selected areas for X-ray energy spectra

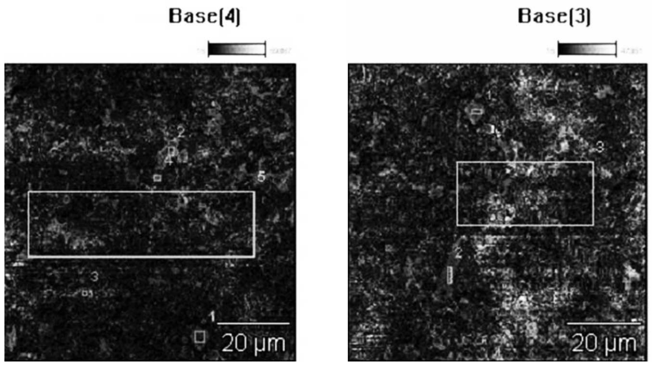


Fig. 3. Structure of tested sample No 2 of catalytic converter carrier coming from Diesel engine car with marked selected areas for X-ray energy spectra

TABLE 4

Chemical analysis for sample No 1 and 2 of catalytic converter carrier coming from Diesel engine car for areas marked in Fig. 2 and Fig. 3

Place	Weight %									
	C	O	Al	Si	P	Ca	Fe	Zn	Mo	Pt
Sample No 1										
Base(8) 1	10.5	44.1	4.6	2.0	8.6	12.3	1.5	10.5	3.0	2.9
Base(8) 2	1.5	43.9	5.2	3.4	9.5	7.8	3.6	10.6	0.8	2.6
Base(9) 1	6.0	50.3	5.7	2.6	9.2	8.7	2.3	9.0	0.9	1.9
Base(10) 1	8.9	51.1	5.2	3.9	8.6	8.6	1.5	8.2	1.2	1.9
Sample No 2										
Base(4) 1	4.5	55.8	31.5	-	-	0.6	-	-	-	7.0
Base(4) 2	5.0	56.0	10.9	3.1	-	4.9	5.1	-	0.1	12.3
Base(4) 3	6.6	42.6	5.4	-	-	5.4	2.5	-	-	29.7
Base(4) 4	32.4	31.7	3.2	1.7	-	5.0	12.8	-	-	10.7
Base(4) 5	6.9	36.7	9.4	-	-	6.3	5.8	7.0	-	27.9
Base(3) 1	10.3	50.7	20.4	-	-	-	3.1	-	-	-
Base(3) 2	8.4	46.9	11.2	3.0	-	-	3.6	-	-	24.1
Base(3) 3	7.4	43.6	12.8	-	-	-	4.4	-	-	31.7

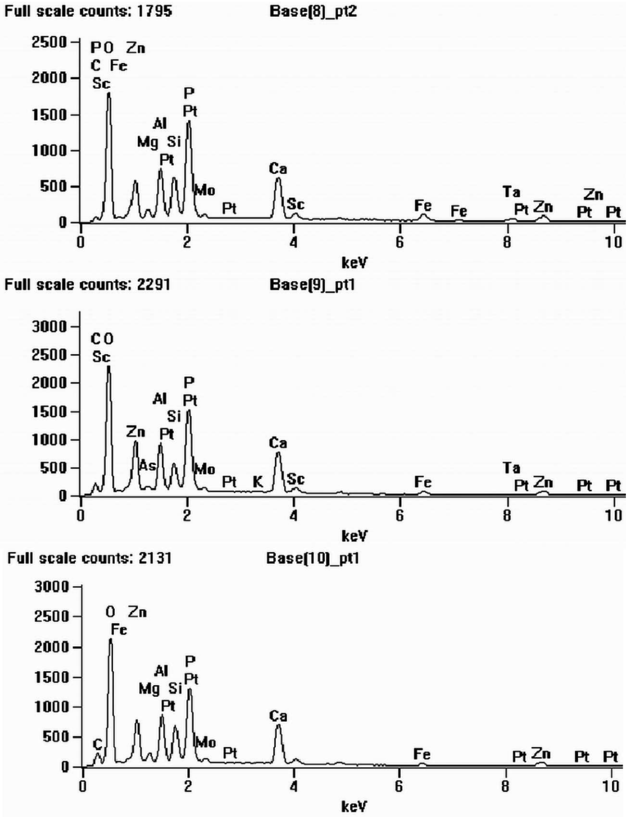


Fig. 4. X-ray energy spectra (EDS) from selected areas for sample No 1 of catalytic converter carrier coming from Diesel engine car

Third sample (No 3) comes from catalytic converter carrier applied in Fiat Punto with petrol engine. Fig. 6 shows the structure of tested sample with marked selected areas for X-ray energy spectra. TABLE 5 presents the chemical analysis for areas marked in Fig. 6, whereas Fig. 7 shows the X-ray energy spectra (EDS) from selected areas. Based on chemical analysis results it can be stated that this catalytic converter contains a low level of platinum, and it should be milled and homogenized with other catalytic converters, preferably containing more platinum.

TABLE 5

Chemical analysis for sample No 3 of catalytic converter carrier coming from Fiat Punto with petrol engine for areas marked in Fig. 6

Place	Weight %					
	C-K	***O-K***	***Al-K***	***Si-K***	***S-K***	***Pt-M***
Base(5) 1	41.2	50.3	4.4	-	4.1	-
Base(5) 2	45.8	41.2	5.5	2.4	4.5	-
Base(5) 3	48.0	24.9	9.2	0.8	16.7	0.3
Base(5) 4	9.9	65.0	7.2	0.4	11.1	0.1
Base(5) 5	14.6	66.1	8.8	1.4	9.0	0.1

Fourth sample (No 4) comes from catalytic converter carriers which were wrongly used, and consequently overheated or poisoned. Fig. 8 shows the structure of tested sample with marked selected areas for X-ray energy spectra. TABLE 6 presents the chemical analysis for areas marked in Fig. 8, whereas Fig. 9 shows the X-ray energy spectra (EDS) from selected areas. Based on chemical analysis results it can be stated that there is no platinum in the sample, so catalytic carrier deactivation is observed, and this carrier should be used only for utilization e.g. to recover aluminium or obtain alumina.

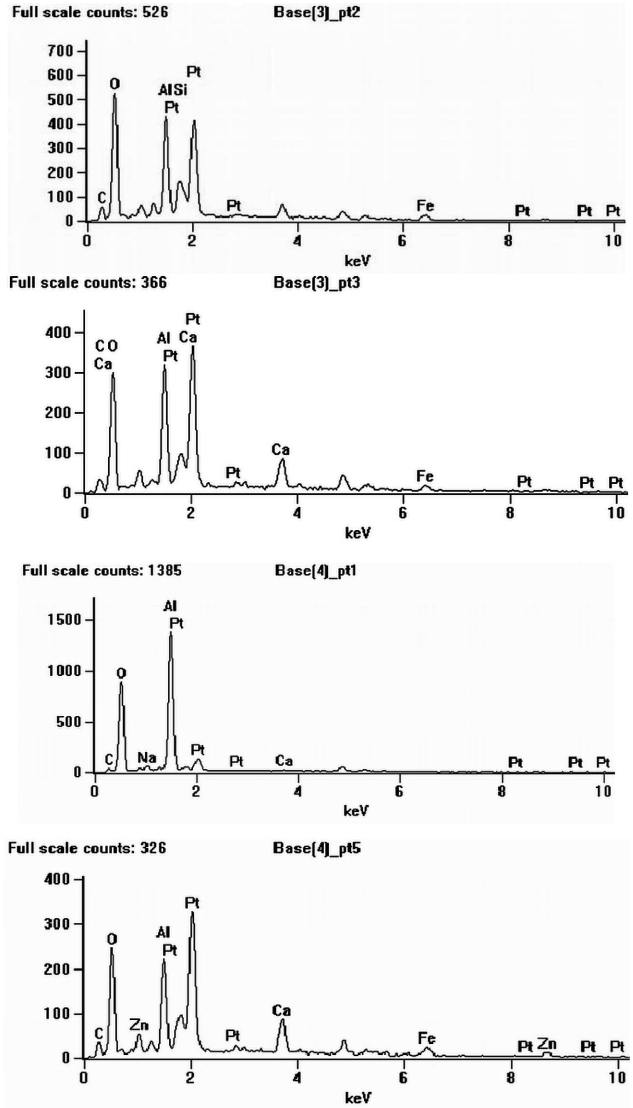


Fig. 5. X-ray energy spectra (EDS) from selected areas for sample No 1 of catalytic converter carrier coming from Diesel engine car

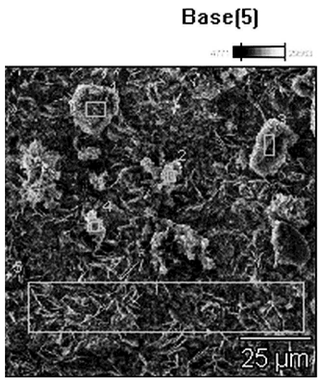


Fig. 6. Structure of tested sample No 3 of catalytic converter carrier coming from Fiat Punto with petrol engine with marked selected areas for X-ray energy spectra

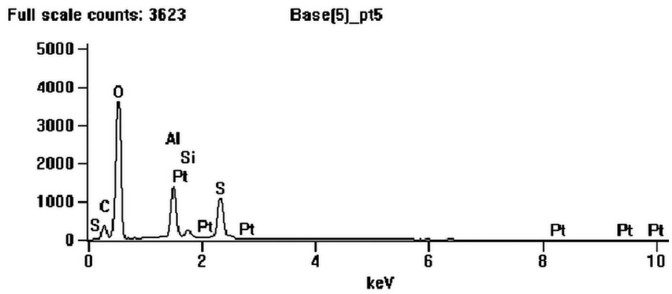


Fig. 7. X-ray energy spectra (EDS) from selected areas for sample No 3 of catalytic converter carrier coming from Fiat Punto with petrol engine

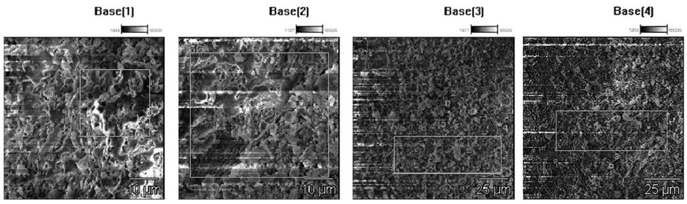


Fig. 8. Structure of tested sample No 4 of catalytic converter carrier which was wrongly used (overheated or poisoned) with marked selected areas for X-ray energy spectra

TABLE 6

Chemical analysis for sample No 4 of catalytic converter carrier, which was wrongly used, for areas marked in Fig. 8

Place	Weight %						
	C	O	Al	Si	P	Ca	Pt
Base(1) 1	-	60.3	15.7	17.7	-	-	-
Base(1) 2	-	61.4	29.0	6.9	-	-	-
Base(1) 3	-	55.0	19.8	19.1	-	-	-
Base(2) 1	-	56.3	23.2	14.7	-	-	-
Base(3) 1	1.0	62.2	31.3	2.2	1.6	1.0	-
Base(3) 2	1.6	59.6	23.4	6.1	4.3	1.8	-
Base(3) 3	-	55.5	18.9	-	6.2	19.4	-
Base(3) 4	-	54.0	22.2	3.3	6.9	6.9	-
Base(4) 1	0.6	59.8	35.0	1.8	0.9	0.6	-
Base(4) 2	2.8	55.2	24.6	1.2	6.1	4.3	-
Base(4) 3	2.2	60.9	29.5	1.4	2.6	2.4	-

Fifth sample (No 5) comes from DPF catalytic converter carrier. Fig. 10 shows the structure of tested sample with marked selected areas for X-ray energy spectra. TABLE 7 presents the chemical analysis for areas marked in Fig. 10, whereas Fig. 11 shows the X-ray energy spectra (EDS) from selected areas. Based on chemical analysis results it can be stated that this carrier contains a big amount of carbon and oxygen. There is a low level of aluminium, whereas silicon, iron and calcium are on average level. Zinc and iron as well as potassium and phosphorous can be found in some places. There are traces of titanium and molybdenum, but there is no trace of platinum.

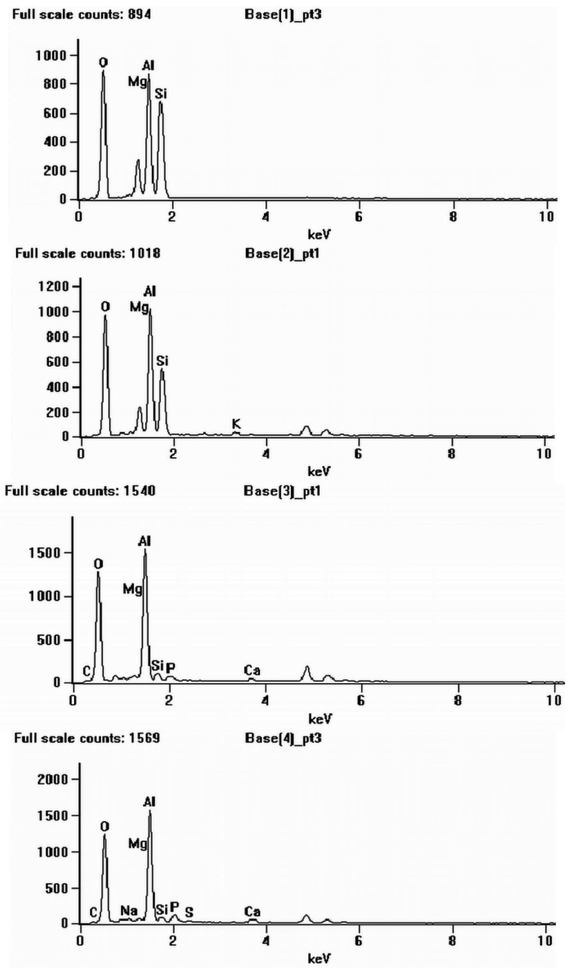


Fig. 9. X-ray energy spectra (EDS) from selected areas for sample No 4 of catalytic converter which was wrongly used (overheated or poisoned)

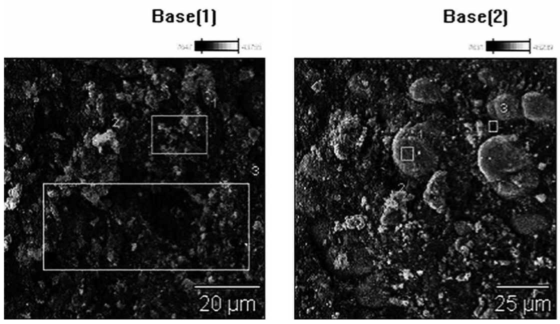


Fig. 10. Structure of tested sample No 5 of DPF catalytic converter carrier with marked selected areas for X-ray energy spectra

TABLE 7

Chemical analysis for sample No 5 of DPF catalytic converter carrier for areas marked in Fig. 10

Place	Weight %								
	C	O	Al	Si	P	Ca	Fe	K	Zn
Base(1) 1	63.1	27.7	1.9	2.4	1.4	1.7	1.9	-	-
Base(1) 2	57.7	37.2	0.3	1.3	0.4	0.6	0.5	1.1	-
Base(1) 3	62.5	21.3	0.5	5.3	2.7	4.2	3.5	-	-
Base(2) 1	20.9	41.1	0.2	17.4	5.2	3.2	1.4	0.3	10.3
Base(2) 2	41.6	26.8	0.5	30.0	-	0.3	-	0.3	-
Base(2) 3	28.0	2.3	0.7	12.5	7.0	11.1	23.3	-	13.0

Sixth sample (No 6) comes from catalytic converter with metallic carrier. Fig. 12 shows the structure of tested sample with marked selected areas for X-ray energy spectra. TABLE 8 presents the chemical analysis for areas marked in Fig. 12, whereas Fig. 13 shows the X-ray energy spectra (EDS) from selected areas. Based on chemical analysis results it can be stated that this carrier contains substantial amount of oxygen, aluminium and iron. There is an average level of chromium and nickel, low level of carbon and silicon. This carrier contains a lot of platinum (2.1 to 7.2%).

4. Possibilities of platinum recovery from used auto catalytic converters based on obtained results

Once the analysis results are known, the method of platinum recovery from catalytic carrier should be chosen. There are many pyrometallurgical, hydrometallurgical and mixed methods.

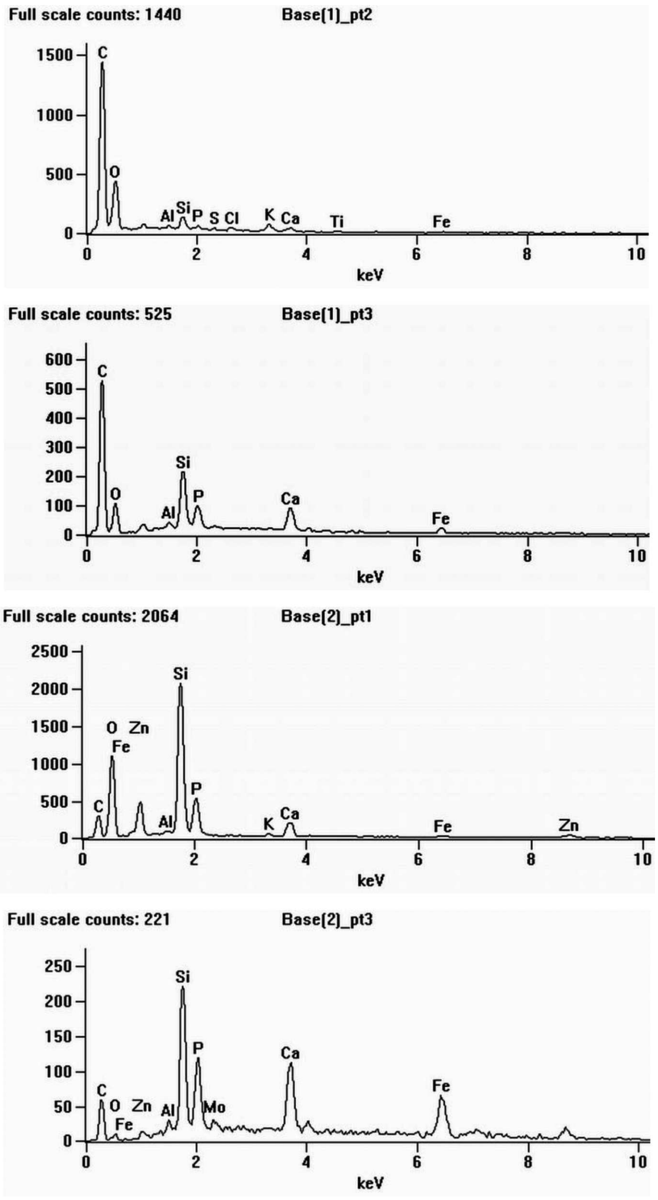


Fig. 11. X-ray energy spectra (EDS) from selected areas for sample No 5 of DPF catalytic converter carrier

In hydrometallurgical method PGM metals go into the form of chloride complexes (MCl_6^{2-}) as a consequence of dissolution in water solution of chlorides, chlorates, chlorine, hydrogen peroxide, bromates, nitrates and aqua regia. Solution obtained in such a way contains PGM metals but their concentration is quite small. Therefore the next stage is concentrating this solution and the PGM metals extraction. During all these processes many liquid wastes are generated which are the potential threat to the natural environment. In pyrometallurgial methods grinded catalytic converter carrier is melted with the addition of other metal in solid or vapour state which is treated as a metal collector. This process allows PGM metals to go to the alloy whereas a slag is separated and becomes a waste. In both methods grinded catalytic converter carrier can be used. The whole catalytic carrier can be used when the amount of platinum in it is relatively high. TABLE 9 presents characteristics of methods used in platinum recovery from used auto catalytic carriers, whereas Fig. 14 presents schemes of some processes.

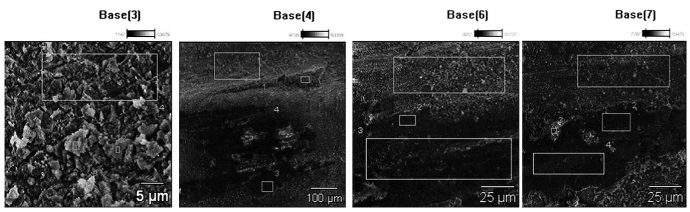


Fig. 12. Structure of tested sample No 6 of catalytic converter with metallic carrier with marked selected areas for X-ray energy spectra

TABLE 8

Chemical analysis for sample No 6 of catalytic converter with metallic carrier for areas marked in Fig. 12

Place	Weight %								
	C	O	Al	Si	Cr	Ca	Fe	Ni	Pt
Base(3) 1	-	51.8	31.9	-	-	-	2.4	-	-
Base(3) 2	-	55.3	37.2	-	-	-	3.3	-	4.2
Base(3) 3	-	46.2	37.2	-	3.1	-	10.6	-	3.0
Base(3) 4	-	48.0	36.2	0.4	2.5	-	9.0	-	3.8
Base(4) 1	-	41.8	27.1	1.0	4.8	0.1	17.4	-	-
Base(4) 2	-	57.4	35.4	-	-	-	-	-	7.2
Base(4) 3	2.3	22.9	18.9	1.3	14.1	0.5	-	13.1	2.4
Base(6) 1	0.5	42.3	28.0	-	6.1	-	18.3	-	4.8
Base(6) 2	0.7	24.2	18.0	0.3	11.8	-	42.8	-	2.1
Base(6) 3	6.8	44.2	22.4	2.0	1.8	1.9	12.8	-	5.0
Base(7) 1	0.3	17.3	19.1	1.2	11.8	-	39.2	8.6	2.6
Base(7) 2	2.7	22.4	18.0	1.7	9.4	0.8	36.7	5.8	2.2
Base(7) 3	4.7	45.9	21.7	4.2	1.1	2.4	12.7	1.1	3.0
Base(7) 3	0.5	13.4	14.0	1.0	15.2	0.3	44.6	9.0	2.1

5. Discussion and conclusions

Today almost half of produced platinum, the majority of palladium and 80% of rhodium are used for the production of auto catalytic converters. The used auto catalytic converters

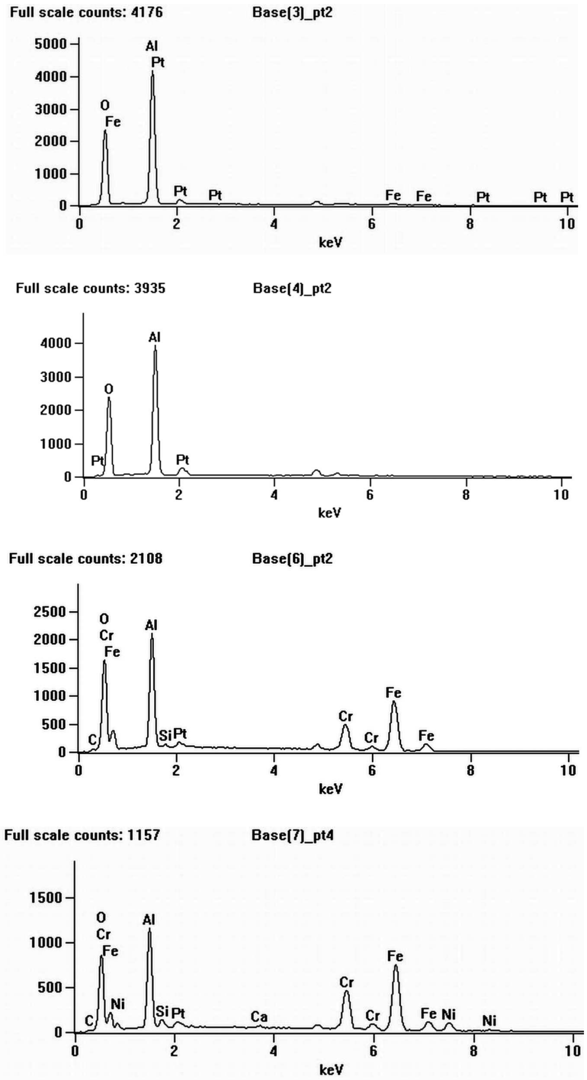


Fig. 13. X-ray energy spectra (EDS) from selected areas for sample No 6 of catalytic converter with metallic carrier

give possibility to recover the considerable amount of platinum. The continuous increase of platinum demand is the cause of still growing platinum prices. However, considering the existing state of the technological development it is very unlikely that platinum group metals shall be replaced (in automotive industry) by other substitute in the nearest future. So used auto catalytic converters have become a very important source of PGM metals recovery. Platinum recovery by means of recycling is very advantageous considering harmful influence of the metallurgical process of obtaining platinum in natural environment. Recycling gives such benefits as limiting the number of waste disposal, saving natural resource, limiting the electricity consumption and diminishing pollutant emission. To get 1 kg of platinum, for example, it is necessary to output 150 Mg of ores from 1000 meters depth. During this process 400 Mg of waste is obtained. The same amount of platinum can be obtained by recycling of 2 Mg of used auto catalytic converters. High purity of recovered metals allows to use them again and does not cause any financial problems.

TABLE 9

Characteristics of applied methods used for platinum recovery from used auto catalytic carriers [11-18]

Method	Description	Advantages/ disadvantages
Rose method	grinded catalytic converter is melted with CuO, FeO, coke, lime and silica in electric furnace; PGM metals are extracted from molten Cu, ceramic carrier goes to the slag	obtained product contains 75% of metals and goes to refinning process, from slag it is possible to recover aluminium
Melting method	catalytic converters are melted with iron in temperature higher than 2000°C, slag from metallic phase is separated due to the difference between its density; obtained metallic phase is leached in H_2SO_4; consequently iron is removed from the platinum solution	very expensive, in the lower temperature other metal can be used to collect Pt; the obtained slag is then less aggressive and the processing conditions are less reactive
Methods based on blowing metal vapours	grinded or whole catalytic converter carrier is blown by gaseous vapours of Cu, Mg, Ca; as a result alloy of metal collector with PGM metals and slag are obtained; then slag is separated	alloy of metal collector and PGM metals should be purified to obtain pure Pt or can be used in this form in other applications
Metal collector method	grinded or whole catalytic converter carrier is melted with the addition of metal collector such as copper, magnesium, calcium; as a result alloy of metal collector (Cu, Mg, Ca) with PGM metals and slag are obtained	slag is easily separated from alloy of Pt and metal collector, what is more this alloy can be refined electrolitically, Pt goes to the slime, whereas copper splits on cathode
Aqua regia method	catalytic converter is dissolve in aqua regia (mixture of HNO_3 and HCl in the ratio 3:1), H_2PtCl_6 is obtained, and the solution is precipitated, by Al/Zn powder; the last stage is platinum refining process	during this method a lot of liquid waste is produced, which should be neutralized; the concentration of solution is quite small
Chlorination	used auto catalytic converters are chlorinated in high temperature; the temperature must be higher than 1200°C to evaporate the metallic fraction	expensive process, using chlorine is dangerous to environment, a lot of liquid and solid waste is created
Cyanide extraction	method based on leaching by means of sodium cyanide under pressure at temperature about 120-180 ^{o}C	expensive method with much waste, cyanides are dangerous to environment
Segregation method	during the grinding process the small addition of KCl and NaCl is used, heating is applied to concentrate the solution; as a consequence a part of solution is evaporated; during the Pt extraction oxygen blow is used	typical hydrometallurgical method, a lot of liquid waste is produced, solution has relatively low level of Pt concentration, so it must be concentrated

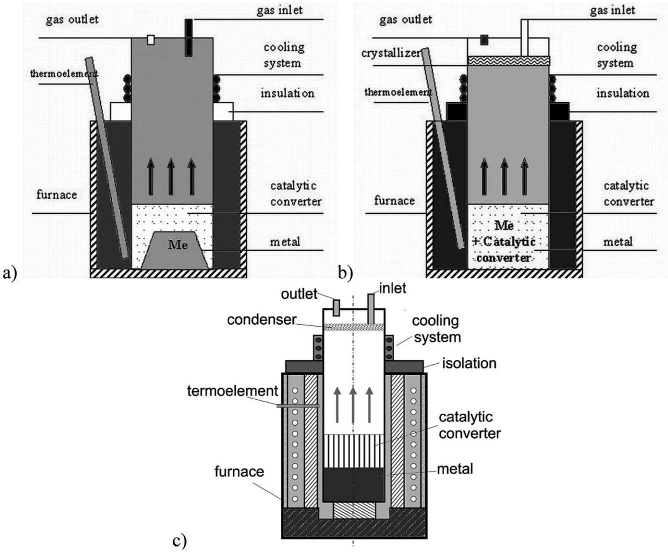


Fig. 14. Schemes of some processes applied in platinum recovery from used auto catalytic carriers: a) scheme of reactors used in the process of melting catalytic converters with metal collector, b) and c) scheme of reactors used for blowing grinded (b) or whole (c) catalytic carrier by metal vapours [11]

All technology of the recycling process is rather complex and consists of many technological stages such as:

- preparation and homogenisation of a carrier,
- upgrading PGM metals content by pyro- or hydrometallurgical methods,
- refining PGM metals concentrate which consists of the following operations: dissolving and removal of non PGM elements, separation of PGM metals, PGM metals purification which gives high grade sponge or powder.

However the content of PGM metals in catalytic converters is very small, it depends not only on the catalytic converter construction but also on the application of catalytic converters and manufacturer. The carried out analysis shows that there are catalytic converter carriers containing high level of platinum (even to 31.7%) – carrier applied in cars with Diesel engine.

There are also carriers containing a low level of platinum, or even no trace of platinum (DPF and when the catalytic carrier is burnt or poisonous). In these cases, and also because the chemical analysis is not possible to be made for every carrier, catalytic converters should be milled and homogenized with other catalytic converters, best of all containing more platinum. As aluminium was found in almost all samples (in DPF catalytic carrier the lower amount), recovery of this metal from slag obtained after metallurgical treatment and separated from e.g alloy containing platinum in metal collector method should be considered. Apart from platinum and aluminium in analyzed samples the following elements were found: carbon and oxygen, silicon, iron, calcium, zinc, chromium, potassium and phosphorous. Additionally, there were traces of nickel, titanium, molybdenum. Catalytic converter carrier contains many elements which can be troublesome, especially in choosing the best method of treatment. There are many technological ways of platinum recovery from used catalytic converter carriers: metal collector, cyanide treatment, chlorination, Rose method, aqua regia treatment, blowing metal vapours. All of them have some advantages and disadvantages. Very interesting seems to be pyrometallurgical method, because there is no liquid waste and obtained alloy contains high concentration of platinum and other precious metals. If this alloy was to be applied directly, no platinum refining (so expensive and time consuming) would be necessary. Another advantages of this method is that in some cases it is possible to use whole catalytic carriers, especially those which contain high level of platinum.

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