

# Stripping of plated plastic materials

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**Abstract.** Many of the nowadays materials used in the large sectors of industry are resuming to the plastics. A first hand competitor of the metals, plastics are more and more suitable for many kind of applications due to their improved characteristics, being also more simple to process and also being more cost effective. Starting from automotive sector going through mass industry and finishing in the medical devices sectors, plastic have been proved as efficient materials, taking into account a more supple finishing without sacrificing the utility and endurance of it. In this paper we are presenting the stripping of the plating that can be done to refurbish plastic waste that may occur in the automotive industry.

## 1. Introduction

More and more plastic workpieces are present nowadays as plastic is widely used in the industry. The can be seen not only for parts that are having a functional role but also for decorative elements used in many assemblies [1],[2].

Plastic materials have a few characteristics that make them a direct competitor for the metals like:

- Low density;
- Low weight – being a very important characteristic in the automotive industry;
- A good combination between rigidity and tenacity;
- High chemical resistance;
- Good isolation characteristics;
- Infinite ways of designing;
- Low processing temperature;
- Low price – high yield.

In the decorative industry, more and more elements made from plastic are used, a good part of them being painted or plated with copper, nickel and chrome, being more resistant and also having a more pleasant touching surface.[3]

As presented in [4], In the automotive industry, furniture and household items are using this kind of plastic materials. As speaking about weight reduction, in the automotive industry, plastics are contributing to a weight loss up to 12-15% from the cars weight and also contributes to a decrease of CO2 emissions.

Plating of plastic materials can be done in two ways:

- Electrolytic process after pretreating in a non-electric process;
- Vacuum metallization, a process that does not use chemicals.

Materials used in the plating process are many but the main two are ABS (Acrylonitrile-Butadiene-Styrene) and ABS/PC (Acrylonitrile-Butadiene-Styrene + Polycarbonate)



**Figure 1.** ABS (in the left) and ABS+PC (in the right).

## **2. Methods for stripping of the metal plating**

In the automotive industry, plastic parts are having a very high utility. Having to produce such a large amount of decorative plastic that needs to meet high quality standards results a large quantity of plastic waste that are hard to recycle due to the metal plating done on their surface. For this details the stripping of the metal plating is vital..

The main objective of this paper consists the stripping speed from the plastic parts with the aid of a chemical process.

The stripping of the plating is a process that implies the fast removal of the oxides from the plastic or metal surface that will be go through another process like painting, gluing, welding or plating. All this processes require a clean and adherent surface.[4], [5].

The stripping process can be structured in the following ways, as metioned in [6]:

- Mechanic procedures, made by sanding with inert or compatible materials with steel or plastics. Sanding can be done with siliceous sands, corundum, glass or stainless-steel microspheres
- Chemical procedures, that can apply to metallic or plastic surface and mainly acids are used, like hydrochloric acid HCl, sulfuric acid H<sub>2</sub>SO<sub>4</sub>, nitric acid HNO<sub>3</sub>, flourhidric acid HF;
- Electrochemical procedures, which compared to chemical procedures, spots or haloes are inexistent, does not use aggressive acids listed above and does not contaminate the surface with abrasive particle as in the mechanic procedures.

## **3. Study case**

In our case the samples were collected from the metal plated plastic material, having different plated areas and also different layers.



**Figure 2.** Sample with a granulation and plated area of 8-11 mm<sup>2</sup>, grinded, with layers of Cr 0,5-1 μm , Ni 40-70 μm and Cu 50-120 μm, initially being processed through a mill.



**Figure 3.** Sample with plated area of 50-60 mm<sup>2</sup>, with layers of Cr 0,5-1 μm , Ni 40-70 μm and Cu 50-120 μm.



**Figure 4.** Sample with plated areas of 60-350 mm<sup>2</sup>, with layers of Cr 0,5-1 μm , Ni 40-70 μm and Cu 50-120 μm.

For the determination of the stripping time for the three samples, there have been used equal quantities of plastic materials, chemical substances and also being used the same procedure for all the three samples.

The quantities were the following: 500g of plastic material – ABS/PC T45, 800 ml of chlorhydric acid (HCl) 37% concentration, 400 ml of nitric acid (HNO<sub>3</sub>) 55% concentration, diluted with 250 ml of water (H<sub>2</sub>O).[6],[7]

er Removing the Chrome (CR) layers

For removing the first metal plating layer with chrome, the samples were immersed in hydrochloric acid (HCl) till the first layer came off. For the presented samples we had the following results:

- For the samples with surfaces between 8-11 mm<sup>2</sup> the plating was removed in 2 minutes

- For the samples with surfaces between 50-60 mm<sup>2</sup> the plating was removed in 3.2 minutes
- For the samples with surfaces between 60-350 mm<sup>2</sup> the plating was removed in 4.5 minutes

#### Removing the Nickel(Ni) and Copper (Cu) layers

After the removal of the Chrome layers. The samples are washed and sent to the next phase. The samples were immersed in nitric acid (HNO<sub>3</sub>) to remove the two layers. Because the reaction produces heat up to 930C it's recommended to cool down the entire process to 70-750C for more efficiency.

- For the presented samples we had the following results:
- For the samples with surfaces between 8-11 mm<sup>2</sup> the plating was removed in 26 minutes
- For the samples with surfaces between 50-60 mm<sup>2</sup> the plating was removed in 41 minutes
- For the samples with surfaces between 60-350 mm<sup>2</sup> the plating was removed in 49 minutes

#### 4. Conclusions



**Figure 5.** The samples after the stripping process.

In conclusion the results for the metal plating stripping were the following:

- For the samples with surfaces between 8-11 mm<sup>2</sup> the total stripping time was 28 minutes
- For the samples with surfaces between 50-60 mm<sup>2</sup> the total stripping time was 44.2 minutes
- For the samples with surfaces between 60-350 mm<sup>2</sup> the total stripping time was 53.5 minutes

After the metal plate stripping of the three samples we found that the parts with the small area were stripped faster because after cleaning the chrome layer, which is eliminated fast, the second stripping process has also an external and substrate chemical reaction that accelerates the stripping process.

After this we can conclude that higher volumes of parts can be stripped if they are having a much more small area resulting a low consumption of chemical. Also for a more efficient process the temperature must be maintained close to 70-750C.

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