RECOVERY OF SILVER FROM SPENT PHOTOGRAPHIC SOLUTIONS USING METALLIC REPLACEMENT METHOD

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Abstract
The recovery of silver from photographic effluent has been carried out. Photographic liquid wastes were collected from two photo laboratories labeled Sample A and Sample B. The recovery was done using metallic replacement method. The study was done by varying the volume of liquid waste and the number of runs for each sample. The results obtained show that an increase in the volume of sample and the number of runs lead to an increase in the amount of silver recovered. The highest amount of sample of silver recovered for Samples A and B are 0.58g/litre and 0.47g/litre respectively. The melting points of recovered silver which are 1115 and 1021 for Samples A and B respectively point to the fact that they contain impurities which increased their melting points. The research shows that it is possible to recover silver from liquid photographic effluent which constitutes environmental pollutant.

Keywords: Pollutant, liquid, waste

Introduction

Silver is a precious metal used in many industrial products, as such, there is great need for its conservation. Some of the places where silver can be used include the photographic industry, X-ray films and wire and cable industries (being good conductor of electricity) (Madamilola, 2006). It is also used in the making of coins, jewelries, decorative items. Finally, it is useful in the making of mirrors which is a component of telescope and microscope and other solar panels. The waste X-ray photographic films contain black metallic silver which can be recovered and re use (Nakiboglu et al., 2001). Silver is used in photographic films because of its high quality as a light sensitive material for creating a photographic image. However, silver can be recovered in photographic materials and re- use because it is not destroyed in the photographic process (El-Sattar et al, 2004)..

The need for silver recovery arises because it is a valuable natural resource which is used in large quantities for many purposes (Nakiboglu et al., 2003). Moreover, its release into the environment needs to be strictly regulated because it can be a source of environmental pollution. The waste from photographic films containing black metallic silver is a very good source for silver recovery when compared with other types of film (Nakiboglu et al., 2001). Also, recovering silver from image processing wastes can minimize the cost associated with image processing. It has been observed that 25 % of world's silver need is obtained by recycling of which photographic waster serve as a good source (Nakiboglu et al., 2003; Shankar et al., 2010).

Various studies have been carried out on the recovery of sliver from waste photographic films (Nakiboglu et al., 2003). Some of the methods reported were however, observed to cause environmental pollution (Shankar et al., 2010). Metallic replacement method was adopted in this study because it can recover good amount of silver with very few units. Moreover, it is more environmental friendly when compared with some other methods. Metallic replacement method makes use of canisters packed with steel wool and some plastic hose for plumbing connections. Silver can be recovered when the silver rich solution flows through the plastic hose and makes contact with the steel wool. The iron goes into the solution as an ion and the metallic silver is subsequently released. Silver can then be collected as sludge at the bottom of the canister or deposited on the steel wool. The silver bearing sludge can thereafter be refined to obtain pure silver. This study therefore focuses on the recovery of silver from spent photographic solution. The method adopted in this study is environmentally friendly and sustainable.

Experimental Methodology

The chemical sample used for the recovery is spent photographic film. The equipment used in this work are as follows: Stainless canisters, Steel wool, Plastic hose for plumbing connection, Measuring cylinder, Funnel, pH meter, Beakers, Weighing balance Retort stand and clamp.

Collection of Samples

The wastes (Samples A and B) were collected from two different sources:
Sample A – A photo laboratory in Keteren-Gwari Road in Minna, Nigeria

Sample Volumes	Weight of recovered silver (g)	
(litres)	Sample A	Sample B
0.5	0.25	0.18
1.0	0.35	0.28
1.5	0.62	0.56
2.0	0.83	0.71

Table 2: Amount of Silver Recovered when the silver solution was run twice

Sample Volumes	Weight of recovered silver (g)	
(litres)	Sample A	Sample B
0.5	0.33	0.25
1.00	0.56	0.30
1.5	0.80	0.68
2.0	1.15	0.87

Table 3: Amount of Silver Recovered when the silver solution was run thrice

Sample Volumes	Weight of recovered silver (g)	
(litres)	Sample A	Sample B
0.5	0.40	0.32
1.0	0.58	0.47
1.5	0.94	0.86
2.0	1.31	1.02

Table 4: Table showing the melting points, Specific gravities and the pH values of Samples A and B

	Melting Point (°C)	Specific Gravity	pH
Sample A	1115	9.33	11.03
Sample B	1021	8.17	8.78

Discussion of Results

Different volumes of the samples were run once, twice and thrice as shown in Tables 1, 2 and 3 respectively. 2.05 g and 1.73 g of silver were recovered from the same volume (5 litres) each of samples A and B respectively for one run as shown in Table 1. Figure 1 shows the relationship between the volume of samples and the weights of silver recovered. From the graph, there is a steady rise in the amount of silver recovered from sample A with each increase in volume compared with the trend in sample B. Sample A appears to have a higher recovery than sample B. This could be due to Sample A containing more silver compound than

Sample B.

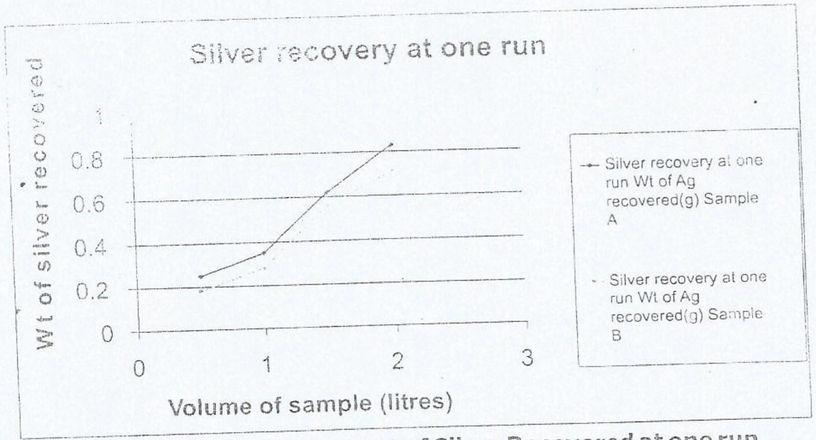

Figure 1: Figure showing amount of Silver Recovered at one run

The results in Table 2 expectedly show an increase in the weight of the silver recovered at two runs. It shows an increase of 0.79g in the weight of silver recovered from sample A while that of B gives an increase of 0.37g. The weight of Sample A recovered is more than that of sample B in a similar manner to one run.

In Table 3, the result of the silver recovered showed a difference of 0.56g between the amount of silver recovered from samples A and B. The weights of silver obtained when the solution was run thrice gave the highest recovery compared with the other two. The expected increase in the amount of silver recovered as the number of runs increase shows that more silver can be recovered as the number of runs increases.

The purity of silver recovered was tested by determining their melting points and specific gravities. The results of the melting point in each case as shown in Table 4 show that each of the melting points of Samples A and B is higher than the melting point of pure silver which is approximately 962°C. This elevation of melting points is due to some impurities present in the recovered silver.

Table 4 shows a difference of 1.16 in the values of specific gravity between samples A and B. Sample A has a higher specific gravity than sample B and they are both less than the standard value of specific gravity of pure silver which is 10.5. The reason for this could be due to the impurities in the samples.

The pH value of sample A has a higher value of 11.03 than that of Sample B with a pH of 8.78. This signifies that the wastes are basic.

Conclusion

This study shows that silver could be recovered from liquid photographic waste. This process can be a mean of reducing environmental pollution as well as silver recycling. Metallic replacement method can be used to recover silver from different sources of photographic wastes although the recovered silver contains impurities.

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