INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 137-143

EXTRACTION OF GRAPHITE FROM USED LUBRICANT

S.K.Narendranathan[1] P.Purushothaman[1] , P.Sengottuvel[1], R.Prasath[2]

[1]Assistant Professor, Department of Mechanical Engineering, Agni College of Technology, Chennai.

[2]Student, Department of Mechanical Engineering, Agni College of Technology. Chennai

Abstract- Graphite is a crystalline allotrope of carbon. Graphite is a mineral made of loosely bonded sheets of carbon atoms, giving it a slippery texture that makes it a very effective lubricant. Super Auto Forge being the leading manufacturers of forged Steel and Aluminium components was in need of an effective solution for recycling graphite from used lubricant. Usually, the used lubricant is disposed into the environment in an eco-unfriendly way affecting our surrounding and also putting the life of microorganisms in danger. The company was striving hard to attain 5S in their organization. The absence of a proper way to recycle graphite containing lubricant paved a hindrance to achieve the same for the company. To overcome these issues, the used lubricant is to be taken and recycled in a cost effective way The main objective of this study is to extract the graphite from used lubricant in a popular forging industry like Super Auto Forge. The recycling of used lubricant by the methods in this study are not only economical, eco-friendly but also a way of income to the industry.

Keywords— Graphite, Lubricant and Recycling.

1. Introduction

During the Second World War, deficiency of adequate supplies of crude oil persuaded the reuse of all types of materials as sources of fuels, especially the used lubricants. With technological progresses and the ever collapsing reserves of fossil fuels, more countries are getting back towards recycling used lubricants to afford their energy demands.[1] The efficiency of used lubricants recycling is about 75–60% and the price of the oil obtained from the regenerative technologies is equivalent to crude oil prices.[2] In addition to this, recycled lubricant oil needs lesser energy

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 137-143

compared to the lubricant oils derived from crude oil. Therefore, governments actually need to manage the used lubricating oils produced as a valuable matter [3].

The selection of the proper die lubricant is a major factor in attaining a successful forging process. Graphite containing lubricant is the prime category of lubricants having graphite as the major solid lubricant. Graphite containing lubricant has proven ability to promote the functions required for a forging lubricant such as lubricate, release, cooling and protection. Base industries, such as steel, have a high polluting potential [4]. Amongst the activities carried out by industries in this segment, we highlight forging, where steel is processed in presses, under high temperatures, which results in its conformation in the desired shape. During the forging, it is necessary to apply a lubricant, in order to reduce the metal-metal friction, aiming at enabling the removal of the forged part from inside the matrix, as well as to cool, protect and extend the useful life of the matrices.[5].

2. Methodology

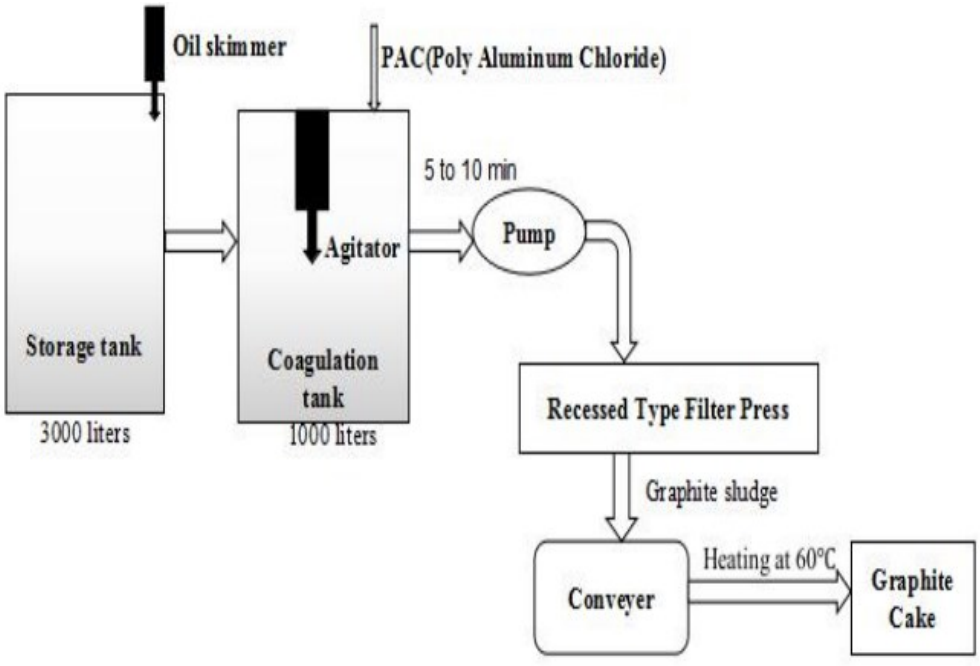

Figure 1: Graphite Extraction setup

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 137-143

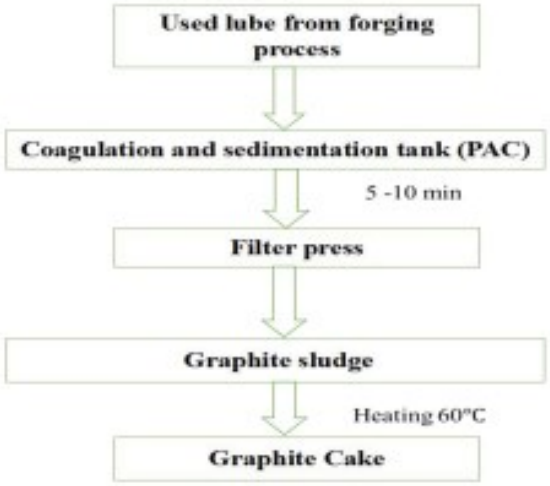

Figure 2: Process Flow chart

The water-based effluent is treated by a physical-chemical procedure in a single step. The effluent is neutralized, homogenized with the injection of compressed air, and then it receives the poly-aluminum chloride (PAC) as coagulant . The dosage of reagents typically applied is 8 g Al/L in the form of PAC, pH adjustment to 6.5. The sludge rich in graphite is dehydrated in a filter- press and stored. The treatment lasts an average of 8 to 16 hours. The configuration of the treatment of the water-based effluent is presented in the Figure 1.

The sample was collected during the three shifts of production, in a total of 25 liters of effluent. The effluent was treated with the same dosage applied in an industrial plant (200 g Al/L in the form of PAC, pH adjustment to 6.5. The 15 average concentration of pollutants in the raw and treated effluent were analyzed regarding the following parameters of water quality: pH, DBO5, DQO, total phosphorus, total Kjeldahl nitrogen, suspended solids, sulfides, aluminum, boron, lead, copper, iron, nickel, zinc, oils and greases. The analysis followed the methodology described in Standard Methods for Water and Wastewater Analysis (SMWW) .

The efficiency of the treatment was determined comparing the water quality parameters established in the Operating License (OL) of the Regulating Environmental

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 137-143

Agency. ¬ The sludge generated was submitted to sedimentation in the Imhoff Cone, vacuum filtered, dried at 60 °C in an oven and compacted. After this the dried sludge was then submitted to a pressure of 100 MPa, in a mechanical press.

Figure 3: Filter press

In this trial we are take the 25 lit used lubricant and adding PAC (200g) to the used lubricant in the mixing tank .Then mixing the chemical to the lubricant put in to the filter press.Filter press is separate the solid content and water content.If the process takes 1 or 2 hours and we get 2.8 kg of graphite sludge. The sample was collected during the three shifts of production, in a total of 25 liters of effluent. The effluent was treated with the same dosage applied in an industrial plant (200 g Al/L in the form of PAC, pH adjustment to 6.5.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 137-143

GRAPHITE MASS AFTER FILTRATION

FILTERED WATER AND CHEMICAL MIXED LUBE

Figure 4: Filtered Graphite

4 Results and Discussion

To confirm the virtue of the graphite extracted, the graphite was given for FTIR test in order to identify the presence of any functional groups in the extracted graphite. Fourier-transform infrared spectroscopy (FTIR) is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. An FTIR spectrometer simultaneously collects high-spectral-resolution data over a wide spectral range. This confers a significant advantage over a dispersive spectrometer, which measures intensity over a narrow range of wavelengths at a time. The term Fourier-transform infrared spectroscopy originates from the fact that a Fourier transform (a mathematical process) is required to convert the raw data into the actual spectrum. The test report is as follows.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 137-143

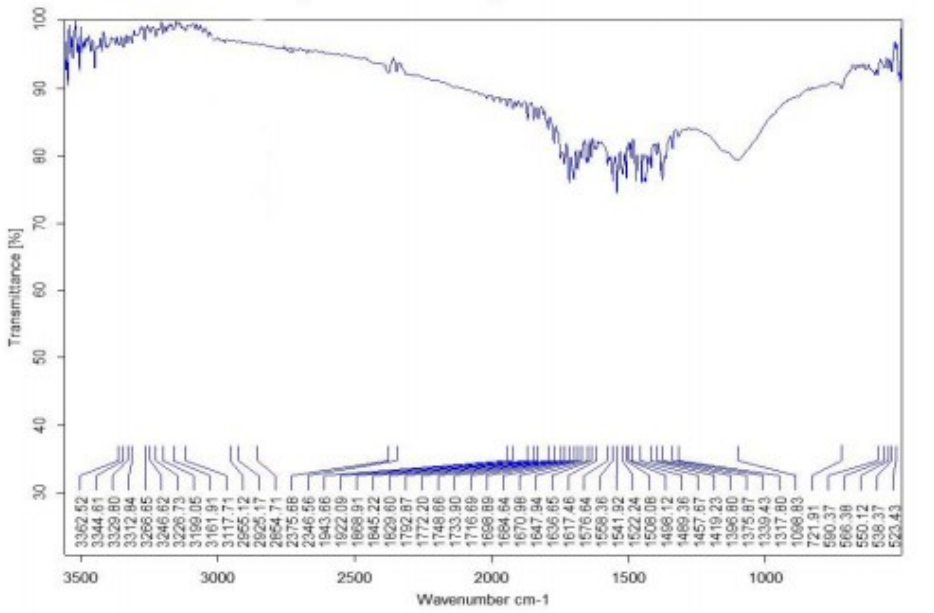

Figure 5: FTIR

X-Ray fluorescence is particularly well-suited for investigations that involve ¬ Bulk chemical analyses of major elements (Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, P) in rock and sediment ¬ Bulk chemical analyses of trace elements (in abundances >1 ppm; Ba, Ce, Co, Cr, Cu, Ga, La, Nb, Ni, Rb, Sc, Sr, Rh, U, V, Y, Zr, Zn) in rock and sediment - detection limits for trace elements are typically on the order of a few parts per million.

Elemental analysis of the sludge generated in the treatment of the effluent of forging (using water-based lubricant) with PAC.The results of the elemental analysis of the sludge are presented in the Table . There is a carbon content of 70.7%, 4.8% of iron, 1.6% of aluminum and approximately 21% of oxygen. Other minor elements were found in very small amounts (less than 1%): chlorides, fluorides, phosphorus, arsenic, boron, cadmium, calcium, lead, cobalt, copper, chrome, magnesium, manganese, mercury, nickel, potassium, silicon, sodium and zinc.

The content of sulphur was 0.33% and of nitrogen was 0.21%.The sludge generated from the laboratory treatment of the forging effluent treated with PAC presents carbon content above 70%. The material is rich in graphite, which opens a range of possibilities for its destination.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 5 Issue 2 – www.ijrmmae.in – Pages 137-143

5 Conclusion & Future Work

Verification of the extracted graphite is also done. ¬ The methods used in this study to extract graphite from used lubricant can be summarized as follows. ¬ In Chemical methods, chemical reagents were used to study the possibility to extract graphite from the used lubricant. ¬ In Mechanical methods, the lubricant nature was initially studied and checked for oil presence. Depending upon the oil content, the graphite can be extracted by using oil skimmer and filter press combinations or by using filter press alone

6 References

1.GRISON, C.; ESCANDE ,V.; BITON J. Introduction: toward an ecology of industrial pollution. new integrated approach to scientific ecology. Ecocatalysis,[s. l., s. n.], p. 8-16, 2015.

[2] SCHAEFFER, L. Consideraçõessobre o processo de forjamento a frio. Forge Brasil, 2016. Available at: <http://www.revistaforge.com.br/artigo-tecnico/consideracoes-sobre-o-processo-deforjamento-a-frio/3027>. Access on: May 6, 2016.

[3] BEHRENS, B. A. et al. Tribology in hot forging, reference module in materials science and materials engineering, from comprehensive materials processing. Tribology International, [s. l.], v.5, p. 211-214, 2015.

[4] KALITA, P. et al. Study of specific energy and friction coefficient in minimum quantitylubrication grinding using oil-based nanolubricants. J. Manuf. Process., [s. l.], v. 14, p. 160-166,2012

[5] WEIDEL, S. et al. Basic investigations on boundary lubrication in metal forming processes by in situ observation of the real contact area. Prod. Eng., [s. l.], v. 4, p. 107-114, 2010.

[6] ZHANG Y.; SHAN D.; XU F. Flow lines control of disk structure with complex shape in isothermal precision forging. Journal of materials processing technology, [s. l.], v. 209, n. 2, p.745-753, 2009