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Research and recycling advancement of used oil in China and all over the World

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Abstract

Used oil is regarded as hazardous waste due to its high concentration of heavy metal, organic substances and perpetual organic pollutants. Our country does not have enough and clear regulation and law on the management of the oil. And the legal recycle company could not compete with the illegal due to the technology and economical limit. Thus the experience of foreign countries, such as America, Japan, Italy, and Germany were introduced. Most countries relied on producer liability, and public policy to help recycle the used oil. The suggestion for Chinese government has been given to adopt tax and law to act as power and pressure to encourage the development of treatment and recycling of used oil.

Keywords: used oil; recycling, hazardous waste, policy

Introduction

Used Oil is derived from petroleum, coal and shale oil, due to some external reasons during the mining, processing and using, its original physical and chemical properties have changed. This kind of oil can not be used again. In daily industrial production mainly includes used lubricating oil, gasoline, kerosene, diesel, hydraulic oil, grease etc. Because of its structural stability, it is difficult degradation. January 4, 1998, the used oil was included in the hazardous waste of eighth largest category. Used oil is indeed harmful to the environment, but also has some recovery value. More and more researchers are concerned about this field.

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1. The source, classification and hazard of used oil

According to its source, used oil can be divided into the following categories: crude petroleum and natural gas extraction; refined petroleum products manufacturing; coatings, inks, pigments and related products manufacturing; specialty chemicals manufacturing; ships and floating device manufacturing and oil-contained waste water etc. In our country, the production of used oil was 37.537 million tons in 2007[1]. Details seen in table 1.

Table 1. The production of national used oil in 2007

<table>
<thead>
<tr>
<th>The source and classification of used oil</th>
<th>The production of used oil (Million tons)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used lubricating oil, chain saw oil, hydraulic fluid, lubricating grease etc.</td>
<td>2925</td>
<td>The national production of used lubricating oil, chain saw oil, hydraulic fluid and lubricating grease is about 6500 million tons, Coefficient calculated by 45%</td>
</tr>
<tr>
<td>Oil sand derived from crude oil and liquefied petroleum gas mining</td>
<td>110</td>
<td>The national production is about 30 million tons per year, moreover, the production of oil sand which derived from crude oil and liquefied petroleum gas mining is more than 80 million tons per year</td>
</tr>
<tr>
<td>Used oil derived from the process of refined petroleum manufacturing</td>
<td>92.5</td>
<td>Manufacture of refined petroleum products processed a total of 370 million tons of crude oil, processing every 1000 tons of crude oil produced 25 million tons of used oil</td>
</tr>
<tr>
<td>Used oil derived from ship-build industry</td>
<td>0.189</td>
<td>Total domestic shipbuilding has reached 18.93 million dwt, used oil production approximately 1 ton/million dwt</td>
</tr>
<tr>
<td>Oil-contained waste water (used oil)</td>
<td>56.8</td>
<td>In our country port capacity is about 3.8 billion tons, ballast water (oil-contained waste water) 15 million tons per billion tons throughput, the oil content of oil-contained waste water is 100g/L</td>
</tr>
<tr>
<td>Used oil derived from ink production</td>
<td>1.95</td>
<td>The national production of ink is 390,000 tons, every 1000 tons of ink produced about 1.26 tons of used oil, total production of used oil from ink 491 tons each year</td>
</tr>
<tr>
<td>Used oil derived from coating production</td>
<td>54</td>
<td>Total production of coating is 900 million tons, each thousand tons of paint produced 60 tons of oil-containing waste</td>
</tr>
<tr>
<td>Total</td>
<td>3753.7</td>
<td>Other industries’ production is small and scattered, not statistics</td>
</tr>
</tbody>
</table>

Harmfulness of waste oil is mainly divided into two types, toxic to people and damaging to natural ecosystems. Due to various different levels additives will be added during the production process of all kinds of oil, such as heavy metals, chlorine, sulphur, and so on, these additives are harmful for human. In
addition, because of high temperature condition and oxidation in use, the used oil may produce many substances, which seriously harmed to human health. Such as 3,4-Benzopyrene(PAH), polychlorobiphenyl (PCB). Used oil pollution is seriously harmful to eco-system, soil, water and plants.

Caused environmental problem arises mainly from the aspects are as follows: (1) Source has no effective monitoring and control, the number of sources are not clear and basic data is scarce; Most of used oil storage condition can not reach the level.(2) Collection is the key link to make environmental pollution: the environmental monitoring of recycling is weak, mostly illegal recycling. (3) Recycling process is seriously harmful for environmental: technology of regeneration fell behind, poor equipment, poor safety conditions, poor product quality. (4) There is an environmental risk to use Recycled products: such as, pollution of black smoke and particles, incineration residues and so on. (5) Serious illegal business and weak law enforcement: even though the used oil industry has begun, we also have related laws, there is lack of supervision and laws enforcement generally. (6) Although a number of policy has been formulated, but the policy relevance is not strong, the operability is not enough, pollution control standards is Inadequate and so on. (7) On the pollution trend and pollution characteristics of unknown, in their various areas of utilization and disposal of environmental pollution and risk identification is not clear.

2. Recycling and treatment status in European and American Countries

Supporting used oil recycling industry has been an important issue in the industrialized countries for the world's energy strategy, German enacted special law for used oils management in 2002 and the used oil must be treated by professional recycling companies and had the priority for the treatment and classification. They also had the detailed requirements for sampling, inspection and custody for the used oil. The producer responsibility, taxation and environmental protection methods were utilized to guide and encourage the used oil recycling industry.

The used oil recycling price was determined by market, the price volatility was linked to the second base oil price for London Stock Exchange Group with the recycle rate of 70%. Italy also enacted the recycle and regeneration. France adopted market investigation mechanism and introduced polluter-pays principle. While Russia enhanced the pollution treatment status, and enacted the used oil recycling standard, thus the used oil source could be controlled and inspected by the government. The used oil collection quantity reached five hundred million, and they have a series of used oil management regulations.

Environmental Protection Agency of United States issued used oil management standards (40CFR279), they had regulations for collection, storage, recycling, incineration and disposal [2]. For example, the recovery rate for used oil in California was about 70%, the Government provided the recycling fund for used oil recycling, 16 cents / gallon (for company), or 40 cents / gallon (for Public), which was the incentive for the oil recovery in California. Angela Group owned the world's largest used oil recycling plant, with the ability to deal used lubricating oil over 300 thousand tons. , short-range vacuum distillation and hydrogenation process were utilized for the recycling the used oil to obtain qualified API Standard Class II base oil.

3. Japan on used oil recycling treatment present situation

Japanese deal with used oil, according to the government of Japan in the last 10 years the implementation of the law for processing. Some related law has carried on the detailed provisions for Inhibition of producing waste, renewable resource recycling, raw materials recycling, Non renewable
resources dealing method etc. At the same time, in some mass production of used oil industry, related industries association promulgated the oil waste treatment guide[3].

Japan sold a total of 1.94 million tons of lubricating oil in 2007, which producing 98 million tons (51%) of used lubricating oil. There are 83 (47%) million tons for recycling. The main recycling pathway divided into Professional Company route for recycling (74 million tons, 38%) and rural, beach fuel (9 million tons, 4%). The recycling pathway of professional recycling companies divided into three ways: (1) production of renewable oil (52 million tons, 27%); (2) burning treatment (2 million tons, 10%); 3, regenerative lubricating oil (2 million tons, 1%). Thus, the production of renewable oil and combustion are the main ways to deal with used lubricating oil, the ability of treating used lubricating oil of the total 73%[4].

Among various industries produced used lubricating oil, can be used for regeneration of the heavy oil feedstock has engine oil, hydraulic oil, turbine oil, transformer oil, no chlorine compressor oil, gear oil and so on; And not suitable to regenerate the heavy oil as raw material were chlorine in metal processing oil (cutting oil), antifreeze, coolant, brake fluid, grease, wax, fire resistant hydraulic oil, silicone oil, animal oil and vegetable oil [5]. As a result of chlorine containing lubricating oil in the combustion will produce dioxin pollution to the environment and reduces the service life of the furnace combustion. Chlorine containing lubricating oil is not suitable for heavy oil as raw material, and also not suitable for combustion treatment; at the same time chlorine oil is widely used in non-ferrous metals, metal products, general machinery, electrical machinery, transport machinery, precision machinery. Chlorinated lubricants recycling has become a key issue in the used oil recycling. In order to promote the oil recycling, the lubricants association focused on the following two aspects to promote the development of the oil industry.

First of all, promoting the lubricating oil’s classification in recovery processing. Dividing used lubricating oil into chlorine, not containing chlorine, not containing water, solvent type four kinds of lubrication oil. The government requires the whole industry of used lubricating oil to classify recycling, ban the use of different kinds of lubricating oil mixed recycling. At the same time, the government asked the oil production enterprises clearly identifies the lubricating oil type and whether contains chlorine oil.

Secondly, promoting the development and popularity of chlorine-free lubricating oil. In the lubricating oil production industry, the government's efforts to make chlorinated lubricants market share now accounts for 5% of the metalworking oil market, reduced to 0%.

4. Used oil recycling status in other countries

In 1992, Korea realized that reduction used oil and recycling was of crucial importance for economy development. Korea established the advance payment system for waste, then changed recycling responsibility system. The regulation stated that used lubrication oil must be recycled and reused by the production units. The recovery and recycling of waste must reach a certain of ratio, the government will impose a fine if the ration is not qualified. To insure the recycling of waste, 11 recycling and disposal waste cooperatives had established. The producers would exchange the responsibility for the cooperatives to establish the used oil treatment equipment, and gave money based on the types and mass of the oil.

Thailand did not have the special regulations for the waste oil collection and disposal, only two relevant laws Dangerous Substances Act and The fuel storage Act existed. The former one stated that the storage oil could not exceed 20kg or 20L, the latter one stated that the underground storage tanks should keep the used oil no less than 400 L. In Bangkok, usually there were independent recycler for used mobile oil, and a lot of recyclers would carry out industrial waste oil recycling. The recycled oil would sold to recycling plant by middlemen. About 7-10% middle men would buy used oil from independent owners. The recycle price for independent owners would be 100-200 baht/200L, the middlemen could buy the oil
with price of 1.8-2.0 baht / liter. After the pre-treatment, a 5-8 baht /liter for used oil would be sold for the middlemen.

5. The experience for China to learn from other countries

With the intensification of the global energy crisis and the rise of the green economy, use oil has become the research hot all over the world, particularly the recycle for use oil has the tendency of high technology and large scale. Due to the economy, the legal used oil recycle company shared the characteristic of small scale, low technology, can not contribute to the whole technology. While illegal companies showed a cluster effect. Our country has issued recycling obligation for production enterprise, which demand the petroleum, petrochemical and other oil production companies to take responsibility for re-use of oil. In addition, the relevant scientific research were carried out to make the technology feasible.

Secondly, China should strengthen policy support in terms of used oil recycling, nowadays the administration liability for used oil belonged to EPA, the Bureau of Quality Supervision, Production Safety Supervision Bureau and Department of Transportation. The main purpose lied in environmental protection, mainly relied on management, policy and inspection. But there existed no clear management department, and authority and right were not precise. We should adopt law and tax tools to strengthen the management of used oil. The experience from the foreign countries should be learned by China to encourage the development of use oil recycling in terms of pressure and power. And to strengthen the combat for illegal used oil Regeneration industry.

Through the joint efforts of the countries and all sectors of society, used oil recycling technology should move forward to specialization and industrialization, realize the reduction of environmental pollution as well as the remedy for shortage of oil resources.

Acknowledgements

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[1] Technical Specifications for Pollution Control of Used Mineral Oil Recovery, Recycle and Reuse ;Ministry of Environmental Protection of the People's Republic of China


