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## **EXPERIENCES IN THE LAST THREE YEARS OF WASTE LUBRICATING OIL COLLECTION SYSTEM**

### *Summary*

*This paper presents the experiences that relate to the handling of lubricating oils when they become waste. Emphasis is placed on problems encountered by the collectors, but they touch upon the problems of other interested parties as well. The system of collecting waste lubricating oils which includes collectors has been in action for the last three years or four counting from when this work has been published. The system of collecting waste lubricating oils includes storage of waste oils at source, collection by collectors and final processing. Of course, the system also includes other components not directly related to the problems of waste handling, such as payment of fees that producers / importers pay for fresh oils and a system of information relating to the management of waste lubricating oils. Interested parties are a manufacturer / importer of fresh lubricating oils, waste lubricating oils manufacturer, licensed collectors, licensed treatment facilities, the Environmental Protection and Energy Efficiency Fund, Ministry of Environment, Physical Planning and Construction and the Environmental Protection Agency.*

*As an introduction a report of the legal document basis and the problems associated with implementing it are given. The available data related to the system of collecting waste oils is given for the years 2007, 2008 and 2009.*

*Some of the problems encountered are related to the requirements of the Fund for weighing at certain scales only, problems with the insistence on the physical and chemical analysis for relatively small amounts of waste oils, problems with faulty physical and chemical analysis or analysis of certain parameters that are missing, problems with improper storage of waste, problems with exporting slide grease, and problems with disposal of waste oils.*

*However, with all these stated above, it should be emphasized that the system of collecting waste oils has significantly been improved compared to the state before. In addition to eliminating the problems mentioned in this paper and certain problems that occur to the manufacturers/importers and processors of waste oil, the system could be bettered significantly.*

**Introduction**

As the government's plan to organize the collection and disposal of waste oils, in the year 2004, the Waste Act (NN 178/04) in art. 4 states the obligation to identify ways of dealing with waste oils. The next step in the organization of collection and disposal of waste oils was the adoption of the Ordinance on Waste Oils (NN 124/06). The Ordinance came out on November 2006 and provisions have been applied from January 1<sup>st</sup> 2007. The first year of implementation of the Ordinance was news to everyone, including producers, collectors and processors, and also considering the fact that the contracts were signed with the collectors in July 2007, that period is not considered in this paper in a way that mentions the problems arising in that year. The collectors were introduced to the system by July of that year, signing a contract with the Fund for Environmental Protection and Energy Efficiency, which have become authorized collectors, and as such the only ones in the state who may collect waste lubricating oils (WLO). From the very beginning of the collection of WLO a lot of different problems appeared. Some of these problems were solved in a very short time, while some problems still remain unsolved. Although there are a lot of operational problems in the domain of day to day business or problems arising from uneducated producers of waste oils, a major problem is still the rigidity of the administration and competent services that are hiding behind the rules, not wanting to start the process for improving the system based on the suggestions of other interested parties.

The system of WLO management comprises of the following stakeholders and actions:

- manufacturer/importer of fresh lubricating oils,
- manufacturer of WLO,
- storage of waste at the site of production,
- collection and transportation of WLO,
- processor and processing of WLO,
- applications, collecting and processing the data regarding WLO,
- Environmental Protection and Energy Efficiency Fond (EPEEF)
- Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC),
- The Environmental Protection Agency (EPA).

The legal basis since the issuance of the Ordinance on Waste Oils has practically remained unchanged. The positive shift can be observed in the issuance of new guidance supplements for the treatment of waste oils intended for interested parties which are starting to solve the problems that had long been warned about. The legal basis which is directly applicable to the waste lubricating oils consists of the following legislation:

- Waste Act (N.N. 178/04, 153/05, 111/06, 60/08 and 87/09),
- Ordinance on Waste Oils (N.N. 124/06, 121/08, 31/09 and 156/09)
- Ordinance on Waste Management (N.N. 23/07 and 111/07),

- Ordinance on the terms and conditions of thermal treatment of waste (N.N. 45/07),
- Ordinance on Waste Management conditions (N.N. 123/97 and 112/01),

The daily work is met with a lot of problems of which are most important:

- problems with the physical-chemical analyzes for relatively small amounts of waste,
- problems with weighing,
- improper storage at the waste producers,
- problems with exports of slide grease.

In any case it should be noted that the alternative to this system of waste oils management (WOM) would probably be the incorrect handling of waste oils, frequent use of the illegal incinerator plants that are used for heating of spaces and a much smaller percentage of collected waste oils in comparison to those that are produced.

With the help of comments and recommendations of interested parties including the goodwill of authorities, this system can become significantly better.

#### **Quantities of generated and disposed waste lubricating oils in Croatia**

By implementing the system of WOM the percentage of collected oil has significantly increased. Quantitative objective set for the system of collecting waste lubricating oils in the year 2010 is the recovery of 90% of the estimated amount of generated waste lubricating oils.

In the table 2 can be seen the quantities of produced, imported, exported fresh lubricating oil placed on the Croatian market. No matter that implementation of the Ordinance on Waste Oils abolished factors of collection, the fact remains that it is theoretically impossible to collect all amounts of oil that are put into circulation. The reasons for the losses are due to volatility, manipulation, transport, methods of use, incidents, losses on filters, etc. For the average recovery factor of 0.5 it would mean that in the Republic of Croatia in 2007, 2008 and 2009 it would be possible to theoretically collect waste oil as shown in Table 1.

Table 1: Reported quantities of manufactured, imported and exported fresh lubricating oils for the period of 2007 to 2009<sup>1</sup>

FRESH LUBRICATING OIL	2007.	2008.	2009.
PRODUCTION, L	13889532,79	13791850,96	11573897,76
IMPORT, L	26437191,09	31686827,21	26901779,94
EXPORT, L	5351322,23	5950175,21	11740710,12
TOTAL PLACED ON MARKET, L	34975401,65	39528502,96	26734967,58
ESTIMATE OF PRDUCED WASTE LUBRICATING OIL, L	17487700,83	19764251,48	13367483,79

In Table 2 you can see the amount of collected WLO that have been reported by the collectors. In year 2009 upward trend was not continued in the collection of waste lubricating oils in quantities, primarily because of significantly smaller amounts that were placed on the market. Encouraging is the fact that about 56% of the total expected amount of waste lubricating oil was collected, the highest proportion since the establishment of the system.

Table 2: Quantities of collected waste oil<sup>1</sup>

	QUANTITY REPORTED collected waste oil		
	2007.	2008.	2009.
WASTE LUBRICATING OIL, L	6794748,61	7853578,11	7538299,98
PERCENTAGE OF COLLECTED WASTE LUBRICATING OIL IN THE TOTAL PREDICTED AMOUNT, %	38,9	39,7	56,4

According to the trend in the Table 2, the default target of 90% would, at best, be reached in the year 2012. This is very ambitious considering that UK and Republic of Ireland collect an average of 86% and 85% in Germany. Yet we are more effective than Greece and Luxembourg, and only slightly weaker than Spain.

The next factor that affects the quality of the system is the number of collectors or concessionaires. As well as performing its primary task of collecting waste lubricating oils, collectors participate in the system with their storage capacities. Thereby they are facilitating the work of recoverers that otherwise would not be able to accept, at one time, all the quantities of waste oils. 56 companies have permits for WLO (group 13 of EWCs) and 77 companies for waste edible oils (EWC 20 01 25). MEPPPC were responsible for assigning concessions for collection and recycling of waste lubricating and edible oils on the Croatian territory. 21 concessions were awarded for collection of WLO, 10 for the collection of waste edible oil, 11 for the recovery of WLO and 3 for the recovery of waste edible oil.<sup>1</sup> Quantities of collected WLO classified by collectors can be seen in Figure 1. Based on all the facts above it can be concluded that there is a sufficient number of collectors for the Croatian territory.

### Problems

From the data in Tables 1 and 2 it is evident that there are still large amounts of waste oils that are not disposed of in the proper manner. If the current trend of increasing percentage of the collected amounts of WLO does not continue, relevant authorities will be obligated to introduce changes to the system in order to achieve the goal of 90% of collected WLO. From the experiences obtained by interaction with the participants in the system it is easy to assume that there are still large amounts of waste lubricating oils that find a way to the black market where they are probably used as an energy source.

It is important to mention that all the collected amount of waste lubricating oils is immediately and fully recovered by authorized recovers.

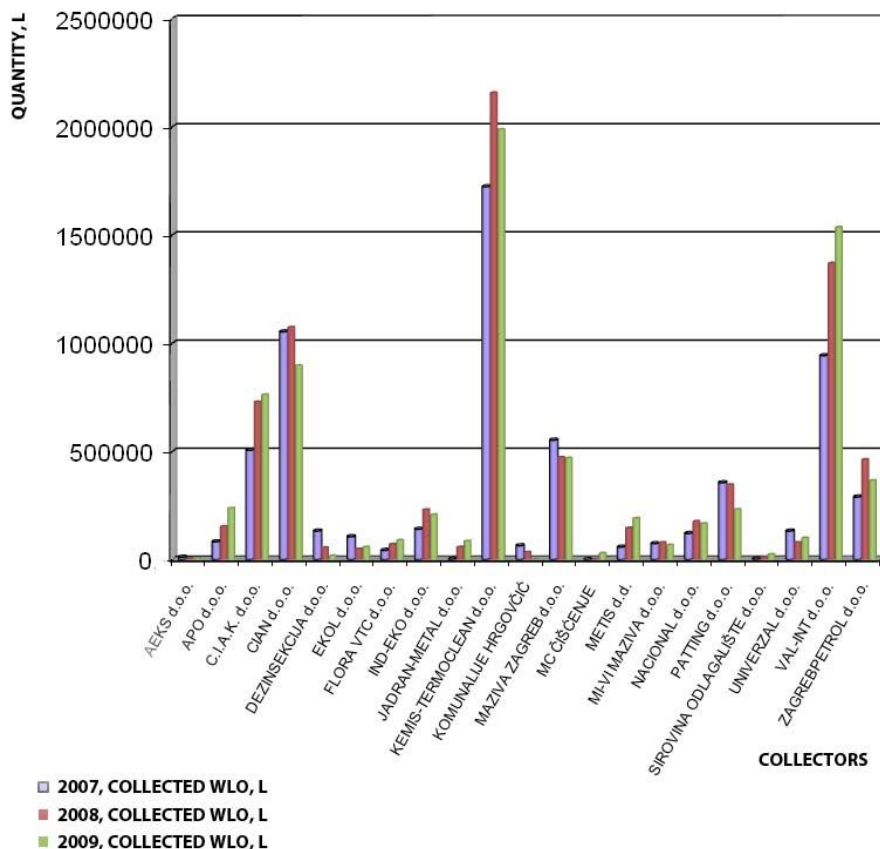


Figure1: Collected quantities of waste lubricating oils according to the reports of collectors, for the period of 2007 to 2009.

### Production of waste lubricating oils and its properties

WLO due to its hazardous properties to the environment, especially water, in case of spills or improper incineration is classified as hazardous waste. Since WLO can be energy recovered very efficiently, it is necessary to ensure that it is possible to collect a large percentage, which will reduce environmental pollution and facilitate the work of the recoverers which can then plan their work. WLO in the Republic of Croatia are exclusively thermally recycled. Theoretically there is a possibility of material recovery, but it takes a lot more quantities of WLO than there are currently available on the Croatian market, as well as costly investments in facilities for recycling.

According to the Ordinance on Waste Oils (N.N. 124/06), art. 3, waste lubricating oils are defined as: "any mineral and synthetic lubricating, industrial, insulation (oil that is used in electric power systems) and / or thermal oil (oil that is used in heating or cooling) that is no longer in use which was originally intended, especially used motor oil, engine oil, oil from gearboxes, mineral and synthetic lubricating oils, heat transfer oils for turbines and hydraulic oils other than oils for gasoline mixture in two-stroke internal combustion engine". Second definition is closer to everyday use and says that the waste oils are, "defined as any oil-based products from crude oil or synthetic oil which through use or handling, become unsuitable for its original purpose due to the presence of impurities or loss of original properties."<sup>3</sup>

Furthermore Ordinance defines the types of waste oils which are divided into four categories:

**Category I** - oils of mineral origin containing halogens below 0.2% and total polychlorinated bi and terphenyls below 20 mg / kg. This oil can be processed and reused for the production of fresh oil.

**Category II** - mineral oils, synthetic and vegetable origin with halogen content above 0.2% and below 0.5% and total polychlorinated bi and terphenyls above 20 mg/kg and below 30 mg/kg. This oil can be used as fuel in power plants and production equipment installed capacity greater than or equal to 3 MW or in kilns to produce clinker in cement factories.

**Category III** - oils of unknown origin and all other waste oils containing halogens above 0.5%, total polychlorinated bi and terphenyls above 30 mg/kg and flashpoint below 550 C. This oil must be burned in the furnaces for burning hazardous waste with a minimum efficiency of 99, 99%.

**Category IV** - polyglycols/oliglycols, waste oils based on polyglycols/oliglycols which are immiscible with the other oils of category I and II and have specific requirements in the process of removal and shall be collected and recycled and/or disposed of separately.

Waste oils are generated in many sectors; the main of which are:

- automotive industry (engine maintenance, fluids that are used in transmissions, fluids used in brake mechanisms),
- industrial activity (metal reforming, the media for heating and cooling),
- other activities (oil from the transformers).

Waste oils, even when not containing amounts of halogens, PCBs and PCTs above the prescribed limits, are considered extremely harmful to the environment because even small amounts can pollute large amounts of drinking water. When they have in their composition PCB's and PCT's compounds, they are toxic, carcinogenic and persistent in the food chain. The following hazardous properties of waste oil that is burning at relatively low temperatures (around 500 °C) releasing highly toxic compounds, dioxins, which then pass from the air in living organisms. Table 3 represents the typical physical and chemical analysis of waste motor oil with EWC number 13 02 05 \*.

Table 3: Analysis of physical-chemical properties of WLO category 1

Parameter	Unit of measure	Value
Heat value, upper	kJ/kg	45478,9
Heat value, lower	kJ/kg	42386,3
Flashpoint	°C	117,0
Content of water	%	0,545
Ash 800 °C	%	0,9
Total chlorine (halogens)	%	0,002
Content of sulfur	%	0,154
PCB	mg/kg	<1
Cadmium, Cd	mg/kg	0,187
Chromium, Cr	mg/kg	0,031
Mercury, Hg	mg/kg	<0,01
Nickel, Ni	mg/kg	0,12
Lead, Pb	mg/kg	2,45
Copper, Cu	mg/kg	25,57
Zinc, Zn	mg/kg	1097,0

### Problems

Already in this first step of WLO management we encounter certain issues. The first problem occurs with the manufacturer of waste lubricating oils that in its composition have slightly higher water content. In one case water was about approximately 20% of the total composition. For this amount of water in the oil the EPEEF would not accept the bills for treatment of oil. Thus the authorized collector is found in an awkward position because they did not receive compensation from the EPEEF, and the manufacturer, of course, refuses to pay the bill since he is offered a free disposal of waste. The foundation of its requirements the EPEEF based on an article in the Ordinance on waste oils:

„Article 2

(2) The provisions of this Ordinance shall not apply to waste oils containing PCBs and PCTs that is above 30 mg/kg, emulsions and oily liquid waste containing in its composition beside waste oil emulsion also other waste oils and other pollutants and water."

Apart from the fact that the article is written unclearly, undefined remains which percentage of water would be tolerated for bills for recovery to be recognized? Assuming that the WLO must not have any content of water, then no WLO would be the subject of system as it always contains at least a small portion of water. Furthermore, the fact remains that the producer/importer of fresh oil has already paid compensation to EPEEF for oil, but it cannot be used in the system. Comments have been repeatedly sent to the MEPPPC about the absurdity of the situation, but it was only in June 2011 when the addition to the guidelines governing the management of this type of waste oils came into effect. Recoverer will in future

determine the water content of each shipment of waste oils and fees will be paid on the basis of these analyzes. There could be a problem for the EPA processing the data, since the authorized collectors will report higher amounts than what the recoverers report to EPEEF. Namely, the collector reports the amount of WLO acquired from the waste producers, and the recoverer aside that it takes over the same amount, reports to EPEEF the amount minus the water content. It is assumed that the EPEEF and the EPA cooperate in the reporting of data, or that the amount reduced by the proportion of water is to stay as internal information of EPEEF.

An additional problem in this step of the system of WLO has appeared with small-scale producers of WLO that produce between 1000 and 2000 kg. The average structure of the producers of WLO, if we exclude those who produce below 1000 kg and over 10,000 kg, is that the vast majority of them are precisely those that produce between 1000 and 2000 kg. Waste Act (N.N. 178/04) says the following for those who produce more than 1000 kg of hazardous waste:

„Article 40.

(1) Where a producer of hazardous waste handing to authorized persons hazardous wastes of unknown composition or when the waste is greater than one ton shall, with information on waste in Article 39 Paragraph 3 this Act, submit a report on the examination of physical and chemical properties of waste. The report must not be older than 12 months from the date of the sampling of waste."

The Ordinance on Waste Management (N.N. 23/07):

„Article 18.

(2) The producer or holder of hazardous waste of the same origin, chemical composition and physical characteristics, of intended processes D and R of Article 4 and Article 5 in this Ordinance, except for D 15 and R 13, when the annual quantity is greater than one ton, to the authorized person is obliged to submit the following declaration in the form of list including the test reports of physical and chemical properties of waste not older than one year, issued by accredited laboratories. Sampling and testing of physical and chemical properties of hazardous waste must be performed only by accredited laboratories. "

According to the above regulations, all who produce between 1000 and 2000 kg of waste oil (and others who produce more) are required to order a report on the examination of physical and chemical properties of waste. The prices of these reports are around 2000 kunas. It should be noted that the same manufacturers that produce 1000-2000 kg of waste oil, are mainly small producers or small businesses with a small turnover for which this is a very large expenditure. Since this is a waste management which is regulated by concessions, therefore, under greater control, it would be expected that the competent authorities made some sort of intervention to ease the burden of small producers of waste oils. For this problem also letters to the MEPPPC and EPEEF were repeatedly sent, but to this day this has not encountered the good will of competent services. It would be necessary to take the initiative to a higher level, say Croatian Chamber of Economy or Society for Fuels and Lubricants,



so the producers of waste oils that produce quantities between 1000 and 2000 kg be exempt from the obligation to execute the said articles. The problem is exacerbated by the fact that these producers often choose to dispose of used oil illegally but to pay 2000 kn for analysis. Since there are such a large number of waste producers, it cannot be expected from the inspection controls to solve this problem.

There is another significant problem that is not limited to WLO but also to all other wastes, and it is significant under-capacity of licensed laboratories for analysis of waste. In addition to the analysis lasting even a couple months, the big problem is that accredited laboratories often do not have free technicians to carry out sampling. This is the burden shifted to the producers who are forced to dispose of this waste without analysis or analysis of samples that they themselves have submitted for what the EPEEF does not recognize the payment of fees to the authorized collectors. Collectors also have the problem with producers threatening to seek the services of other collectors who will take the waste that currently has no analysis. In any case, this is a significant problem for all types of waste and there is a need to bring high-level initiative to facilitate the establishment and operation of licensed laboratories.

#### **Transport of waste lubricating oil**

According to the Waste Act (N.N. 178/04) and the Act on Transport of Dangerous Goods (N.N. 79/07) WLO must be transported according to the international ADR regulations. In itself, this is not a problem, especially for companies who transport such substances in daily operations, but problems arise with the manufacturer of waste. In fact, any company that is in any way involved in the transport of dangerous substances, even if only as a sender, must have a trained security advisor licensed from the Ministry of Transport and Communications. Of course those small businesses and sometimes large ones too, do not pay attention to such things. According to international ADR regulations sender is required among other things, to fill out and submit the list of carriage of hazardous substances in wastes. It is extra work for collectors since they must fill out the lists.

#### **Storage of waste lubricating oil at the producer of waste**

After the use fresh lubricating oil becomes waste it is necessary to temporarily store it at the producer of waste.

Storage is usually done in 200 L metal barrels. It is essential that producers of WLO pay attention to storage conditions prescribed by various regulations:

- the containers are covered, or have a certificate that can be kept outdoors,
- have a double wall or a collection vessel which can accommodate at least 10% of the total content and a tank of largest volume located above it.

Now there are a number of companies engaged in importing containers and issuing certificates. There are also companies that produce high-quality collection containers, so that except for bad financial situation in certain companies/trades there is no justification for lack of tanks.

What poses the problem with the collection of waste lubricating oil by the manufacturer is generally lack of education and, in the absence of a better word, laziness towards the separation of waste at the site of emergence. Cloths often end in storage tanks for oil, which is quite a problem since the WLO is collected using suction tankers and this can cause a halt.

It is also noted that some manufacturers mix waste antifreeze with waste oils in order to save on disposal costs of the same, since the collection of waste antifreeze is not free for producers of waste.

It also happens, though rarely, that the WLO is faulty declared so the two types of oils mix that otherwise cannot be mixed. The result is a sudden increase in viscosity which is a problem for pumps that pump WLO.

Another problem that is often encountered is that many shops do not have a specific responsible person who will be present when transporting WLO, or they are not available. Usually the approval of required documents then lasts too long.

### **Temporary storage, processing and registration information on waste lubricating oils**

The next step in the system of management of WLO is temporary storage at authorized collectors, waste treatment at processors and reporting of data to responsible authorities.

As for the temporary storage generally there is no problem because collectors themselves organize it. Of course it should be noted that for the appropriate equipment it is necessary to spend fairly significant funds. The problem can possibly be found in the fact that no authorized recoverer can be found in the county that produces the most WLO - City of Zagreb and Zagreb County, and for that reason there is the need to establish temporary storage. If there were at least one processor WLO in the Zagreb area, transportation to the recoverer would generally be organized in such a way that it is directly driven from the manufacturers to the recoverer. This would save on transportation costs and reduced carbon footprint.

Recovery of WLO, or transfer to the recoverer, is currently running smoothly. Dates for unloading are agreed with the recoverers and WLO is brought together with the collective physical and chemical analysis of the transport. Problems started to emerge when the EPEEF began to require from the recoverers that in addition to having certified scales, which all the recoverers had, to have scales with electronic printing and storage of data. This of course was an unreasonable request, but the recoverers due to lack of will to drag the thing through the courts, decided to invest in an electronic system.

Another problem that is encountered in this step is export of lubricating grease. For this type of waste a recoverer does not exist in Croatia. The only way to dispose of such waste is burning in incinerators abroad. Before the export of such waste you must obtain the consent of the EPEEF. The EPEEF first sought obtaining a written consent of all licensed recoverers from Croatia that they are not able to recover the waste.

So it happened again that the authorities shifted work to other parties since the Ordinance on Waste Oils says the following:

"Article 16

(3) In the case of waste oil collected on the Croatian territory when there is no authorized company for material recovery and/or heat treatment and/or disposal of waste oils authorized collector shall, with prior approval of the Fund, organize the recovery and/or disposal of wastes outside Croatia and has the right to cover the costs charged to the owner.

Article 32

(1) The Fund shall keep records of the producer and the quantity of fresh lubricating oil placed on the market.

(2) The Fund shall keep records of persons authorized to collect waste oil and authorized persons for the recovery and/or disposal of waste oil."

Because the Fund keeps track of the recoverers this answer should be obtained directly from the Fund rather than collectors who must use their resources seeking approval from company to company throughout Croatia.

### **Conclusion**

By introducing the system of waste lubricating oils definitely the situation has improved on the field as far as the amount of WLO that have been collected is concerned. There is a trend of increasing share of collected WLO. In order to achieve the goal of 90% collected WLO of the total produced will need more investment in the system. Also it should be noted that the alternative system of waste oil would probably be incorrect handling of waste oils, frequent use of the illegal plants that are used for space heating and a much smaller percentage of collected waste oil in relation to the quantity produced. As a major obstacle to increasing the proportion of the collection of WLO is probably the black market where the oil is used as fuel.

Problems encountered during implementation of this system are: non-recognition of bills for the disposal of WLO with water in its contents, insisting on the reports on the physical-chemical properties of the waste for manufacturers who produce between 1000 and 2000 kg of WLO, under-capacity of licensed laboratories for analysis of waste, improper storage of waste at the site and its separation from other waste and transference of the Fund's liabilities to other parties.

Some of these problems were solved very easily, such as the recognition of bills for the WLO that contain water, according to an analysis of the recoverer in supplement form and instructions to collectors and recoverers. This example shows that with the goodwill of the competent services some of the problems can be solved very easily. As the most important problem remains that small producers of waste who produce between 1000 - 2000 kg of waste must allocate significant sums for waste analysis. In relation to this problem an initiative could be undertaken at the Croatian Chamber of Commerce, or the like, in cooperation with the competent authorities for the respective amounts of waste be exempt from this regulation.

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lubricant oil, waste lubricating oil, collection of waste lubricating oil, transportation of waste lubricating oil.

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