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MANAGING OILS AS HAZARDOUS INDUSTRIAL WASTE

Abstract: *The management of waste oils is one of several key issues in the field of environmental protection. One of the leading problems is how to manage and process hazardous waste, including liquid hazardous waste oils. Due to the increasing amount of this waste, it is reasonable to be concerned about how to manage waste oils without harmful effects on the environment. The obvious problem with waste oil management in Serbia is insufficient laws and regulations in this area, as well as the fact that waste oil has been illegally incinerated, spilled and disposed. The adoption of the Waste Oils Directive and the Law on Waste Management set the legal framework for the management of waste oils, thus opening the possibility for investment and business in this area.*

Key words: waste, waste oil, management, storage, treatment.

INTRODUCTION

From the standpoint of environmental protection, waste oils are one of the biggest problems due to their negative characteristics on basic environmental elements such as water, air, soil, climate, human health and other wildlife. Inadequately treated and stored waste oil may cause the greatest harmful impact.

In Serbia, the only practical way to manage waste is disposal at the local landfills which mostly do not satisfy even basic sanitary and technical conditions, and some of the existing landfills are virtually full. At the present moment, there are very few landfills that may be included in a sanitary landfill in Serbia. Integrated waste management system represents a series of actions and activities that includes:

- Prevention of waste generation,
- Reducing the amount of waste and its hazards,
- Waste treatment,
- Planning and control activities and processes of waste management,
- Transport of waste,
- The establishment, operation, closure and maintenance of waste treatment plants,
- Monitoring,
- Counseling and education regarding business activity and activities in waste management.

This system is based on the selection and implementation of effective technologies to achieve specific goals of waste management with the appropriate regulations. The main prerequisite for a successful implementation and operation of an integrated waste management system is specified hierarchical functioning of the activities within it.

Whether waste oil is characterized as hazardous waste and whether it is necessary to reduce the quantity at the source of generation are the subjects of the National Waste Management Strategy. This strategy is made according to the large number of goals of interest to all levels of management - from local government to the republican level. It is necessary to sort out the following:

- Protection and enhancement of the environment,
- Protection of human health,
- Achieving the principles of sustainable waste management,
- Changing attitudes towards environmental protection and waste, as one of its segments,
- Increase public awareness.

Waste and waste management

Waste is any material or object that is produced by a production process, service or other activities, items excluded from use, and waste materials generated in consumption which, from the standpoint of producers or consumers, are not for further use and must be discarded.

Inadequate waste management is one of the biggest problems in terms of environmental protection of the Republic of Serbia and exclusively the result of inadequate attitude of the society towards waste. The waste is divided in several ways: according ti its composition, the place of origin, toxicity, see Figure 1.

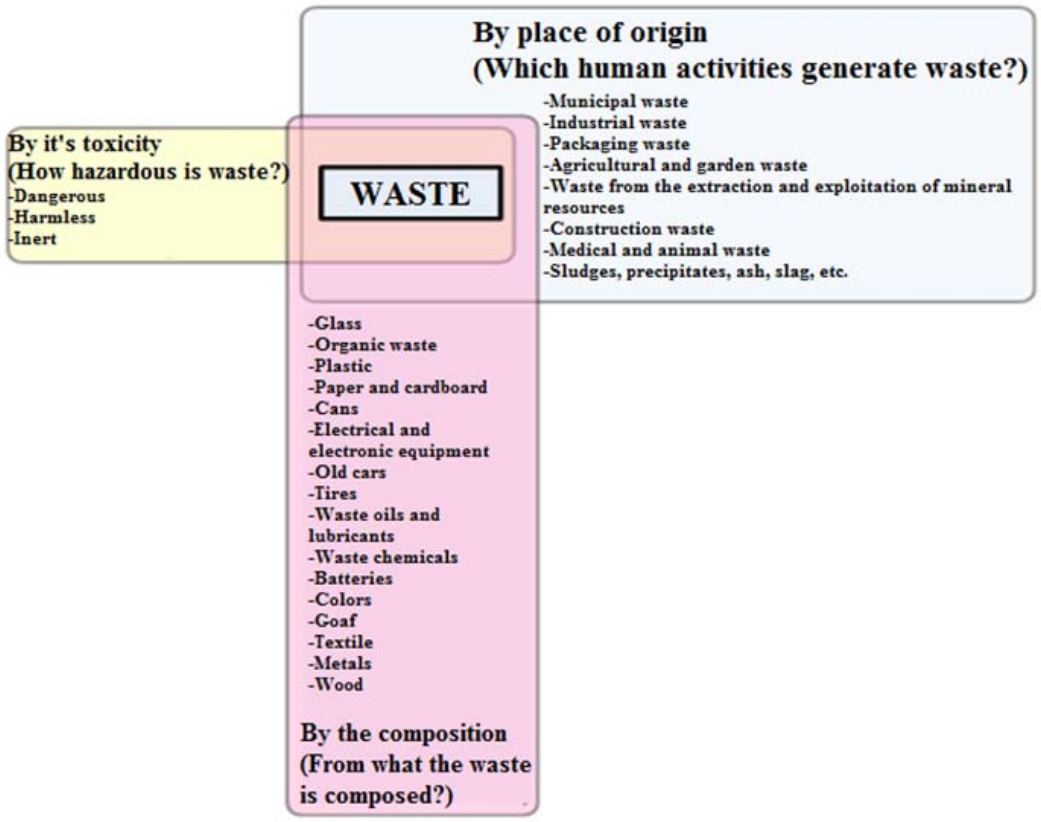


Figure 1. *Types of waste*

Management of waste oils

Mineral oils are petroleum products and their main function is to serve as a lubricant. After the expiry of the use value due to its characteristics waste oils are classified as hazardous waste. Extremely high possibility of recycling waste oils emphasizes the need for collecting large quantities to preserve the environment and regulate the consumption of natural resources.

Management of waste oils is a set of measures that include collection of waste oils for material use or use for energy purposes or otherwise for final disposal when they can not be used.

Management of waste oils must be conducted in a manner which does not endanger human health and the environment. Managing waste oils is strictly prohibited in following cases:

- discharge of waste oils into surface water, ground water and drainage systems;
- disposal and discharge of waste oils harmful to the soil and any uncontrolled discharge of residues from the processing of waste oils;
- the use and disposal of waste oils causing air pollution above prescribed limits of applicable regulations and which have a negative impact on human health and wildlife;
- collection of waste oils in tanks that are not regulated or equipped for reception of waste oils.

To perform the tasks of collection, storage and treatment of waste oils it is necessary to:

- have adequate space,
- proceed with waste materials in the prescribed manner,
- maintain proper documentation of the amount collected, stored or treated, as well as the final disposal of residues after treatment.

Lubricant waste oils are disposed in special containers for collection of waste lubricating oil which must be impermeable and closed and with the prescribed mark of key number of waste oil and should also have label categories of waste oil.

Figure 2. *A container for waste oil*

The possibility of utilization of mineral waste oils

Estimates of the quantities of waste mineral oils which are generated in the Republic of Serbia are incomplete, ranging annually about 106,000 tons of waste motor oils and 275,000 t monthly of organic-aqueous emulsion. It should be kept in mind that there are very few plants that treat waste oil in Serbia. However, the largest amount of waste oil from motor vehicles end up in landfill or in the sewer. A large part of the used oil is burned uncontrollably in home furnaces, used for protection and impregnation of wood, for lubrication of various molds, weed removal, dust.

Treatment (recycling) of waste oils creates the possibility for reuse, and depending on the method of treatment can have the following applications:

- Includes new products,
- Allows the reuse of waste oils,
- Allows the heat treatment process, ie. use waste oil for energy purposes,
- Waste oils are in appropriate technological procedures getting prepared for disposal or further processing or use.

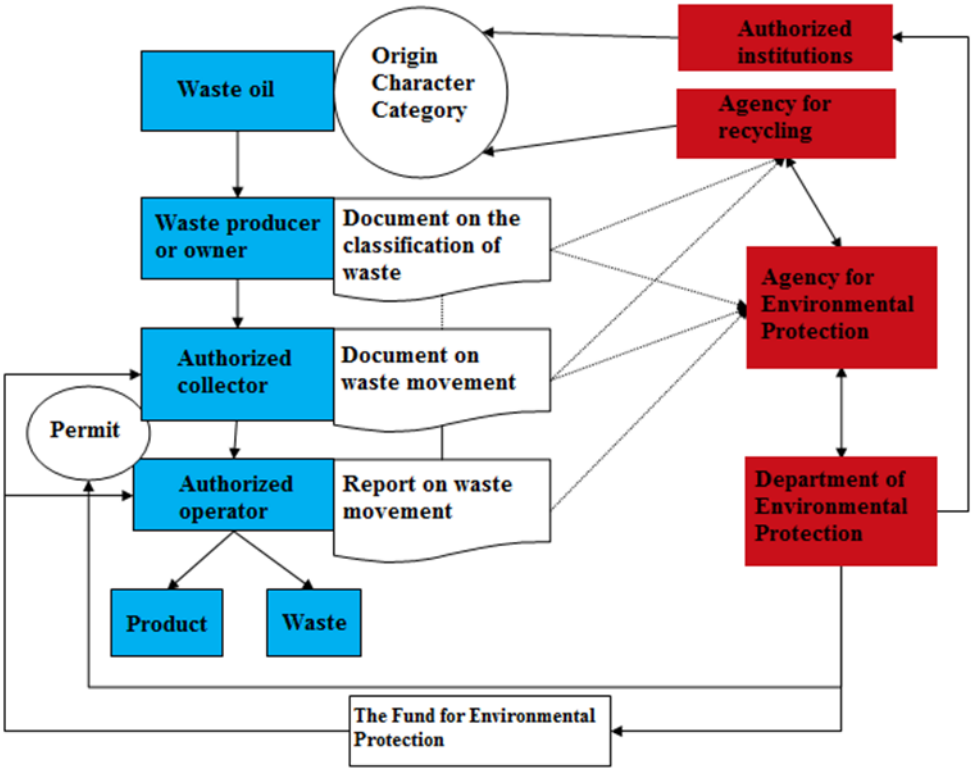


Figure 3. *Flow diagram of managing waste oils*

Currently the largest use of waste oil is as fuel due to its basic features that can physically burn. For this reason, the use of waste oil as fuel is fully comparable with other energy sources, especially heavy fuel oil and natural gas.

Of all the methods of waste oil recycling, refining requires the most rigorous conditions and relatively complex systems in order to obtain good quality oils.

The primary application of waste oil in the EU is for energy purposes. Table 1 shows the percentage share of regeneration of waste oils or use for energy purposes in the total amount collected of waste oil in some EU countries.

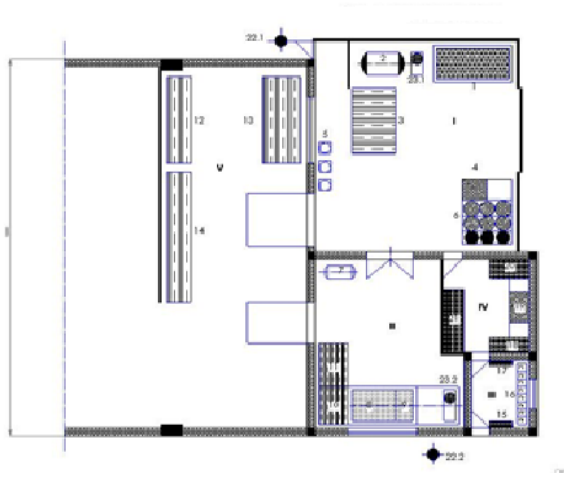
Table 1. *Utilization of waste oil in the EU*

Country	The amount collected (kt)	Degree of collection (%)	Application for energy purposes (%)	Regeneration (%)
Austria	34	74	74	0
France	243	56	37	19
Greece	22	37	28	8
Ireland	17	86	86	0
Italy	200	74	18	55
Netherlands	60	72	72	0
Spain	105	47	31	16

One of the ways to obtain oils for energy or other purposes is the treatment of equipment and parts which are contaminated with oils.

The technological process of treatment of oil-contaminated parts and equipment

The aim of the technological process of treatment of oil and grease-contaminated parts and equipment is to degrease them by controlling the extraction of oils, if there are any in the equipment (oil transformers, oil switches, hydraulic motors, etc.). Combined degreasing equipment is decomposed into appropriate dimensions and it can be completely rationalized in the process of decontamination and removal of the remains of degreasing. The goal of this process is to clean up hazardous waste contaminated with oil from oils and dirt and get a non-hazardous waste that can be used as a secondary raw material.



Legend
I area for treatment of oily large sized equipment
II area for treatment of oily small sized equipment
III area for the electrolysis of fixer
IV area for manufacturing and packaging adhesive
V storage

Figure 4. *Block diagram of the technological process*

The process of degreasing equipment and oil-contaminated parts

Degreasing process is carried out within eight stages or groups of activities:

- reception of oily equipment and parts,
- examination, classification and measurement of equipment and parts,
- extraction of oil from the equipment,
- dismantling of the equipment that was taken without oil and equipment drained of oil,
- degreasing of equipment and parts,
- squeezing and drying equipment parts,
- control of processes and products,
- storing degreased equipment and parts.

The secondary process involves the following activities:

- reduction of the volume-grinding plastic materials separated during decontamination,
- preparation and recuperation solution for degreasing.

Receiving equipment and its parts. The actuator 1 is the plant for oily degreasing equipment and its parts, i.e. treatment and use of metals, plastics, ceramics and others. In the form of oily equipment and parts the same contaminated with oils and greases, hazardous waste is entered by the technical gate where it gets noted received documentation, updated records and equipment brought into the actuator. Movements of Hazardous Wastes are necessarily accompanied by a document on the movement of hazardous waste in accordance with the Law on Waste Management.

Overview, sorting and measuring equipment and parts. After unloading and handover of hazardous oily waste, access to other group the activities i.e. inspection, classification and measurement equipment. The criteria for classification involve:

- The nature and purpose of equipment in the normal state (transformers, switches, motors, pumps, etc.).
- Presence of oils as is (whether the equipment used oil as the working fluid, and whether it has as seen in the equipment).
- The degree of grease soiling equipment and parts.
- Applicability, suitability equipment for treatment depending on the size.

Extracting oils from the equipment. If there is oil in some equipment, it can be extracted. An adequate suction-pressure pump is extracting oils from the equipment and its streaming in prescribed packaging.

Equipment with oil inside is set to a bund of the low dimension 2000x4000x400 mm, consisting of the impermeable metal tubs, the cover of the rigid grid, which can bear a very large weight. By approaching equipment, a forklift descends the same over a supporting grid.

Firstly, it is necessary to remove the expansion containers, dismantle isolators and remove the cover of the transformer which has completely opened. After connecting the intake manifold in equipment, suppressed branch pump plugs into containers (drums) and performs streaming of oil from the equipment in the packaging.

Finally, discharge transformer from oils is performed by opening the valve at the bottom of the transformer which allows complete emptying of the transformer oil. This group the activities primarily is related to the oil distribution transformers that are definitively known that in working condition contain certain amounts of transformer oils.

If the examination of certain equipment determines that there is no oil just grease, it is not subject to the activities of drawing oils but moves to the next stage, which is the decomposition or removal equipment.

Figure 5. *Transformers for degreasing*

Dismantling equipment without oil and oil drained equipment. Equipment free of oil as well as equipment drained of oil on the receiving bund wall exceeds the following group of activities, and that is dismantling of equipment.

The purpose of this group of activities is to apply criteria by which to degreasing is satisfactory, and they involve:

- Criterion of separation tanks in which there were oil as the working fluid,
- Criterion of separation the working parts (cylinder, etc.) where was conducted activity of working potency,
- Criterion by which the assemblies, subassemblies and parts equipment to its dimensions best expose to degreasing process,
- Criterion by which the parts by weight are separated for further processing flow and others.

Degreasing equipment and equipment parts. The further course of treatment, i.e. degreasing surfaces contaminated with oils or greases, takes place in two directions depending on the dimensions as follows:

- degreasing scale equipment will be carried out on site or at the same bund wall at which performs the extraction of oil from the of equipment;
- degreasing parts of components that do not have large dimensions will be carried in the bath for degreasing.

Figure 6. *Tub for degreasing*

Squeezing and drying. This phase is essentially the same, only the dispositional occurs in different places depending on whether the equipment is smaller or larger dimensions. For larger sized drying, equipment is provided at the receiving bund wall where equipment is degreased. Drying equipment is achieved by blow-by blowing compressed air. For equipment of smaller size drying is provided within the room where the tub for degreasing. Drying by means of compressed air is carried out with a mobile compressor.

Control of the process and products. Quality control of the product, and thus the control of degreasing are carried out by n-hexane, and a test strip. The control of equipment large and small sized equipment is the same, with the exception that the disposition is performed in different places.

The first method of control, in the course of setting up the technological process shall be performed using n-hexane in the existing laboratories. N-hexane represents a low boiling hydrocarbon in which floods the filter that was set up and held for a short time on the cleaned surface. If the surface is not well degreased, the filter on it will take a certain amount of hydrocarbons that will be dissolved in n-hexane and their condition to show the state of the quality of the cleaned surface. Usually it is a very small amount of n-hexane from about 50 l. This amount, if contaminated with the appearance of oil after degreasing, is deposited together with other residues occurring treatment.

Another way to control is the control of strip-test. This method is very simple and is based on the fact that, if the surface is in any way degreased, glued to the tape itself, which confirms that there is no oil film on a given surface, and finally confirms the quality degreasing processes.

Storage degreased equipment and parts. After obtaining the desired results, compiling reports on the inspection of the product, after final measuring and marking, finished product, which now represents a non-hazardous waste refers to the space reserved for the temporary storage of de-oiled machinery and its parts.

Reducing the volume, grinding plastic materials separated during disassembly. After treatment of hazardous waste and quality control, it is projected for more rational use of space, to part of non-hazardous waste which is plastic, comminuted in a mill. Plastic defatted pieces of equipment will first be put into a container of raw capacity of 2000 kg, and when they are filled will begin with comminuting. Shredded plastic is packed in jumbo bags and temporarily stored in the same room until removal to another location, recycling center for non-hazardous waste -secondary raw materials for further treatment.

Preparation and regeneration solution for degreasing. For degreasing equipment of large and small dimensions, the same solution is provided (Soluble agent CHIMIGAL Srl Italian manufacturer under the trade name pulmotor), but in different concentration: concentration of 10-15% for degreasing equipment larger size and concentration of 5-10% for degreasing equipment of smaller size.

CONCLUSION

The reasons for further research of waste management in particular categories of hazardous waste, mainly waste oils in the management of quality of working environment, come together with the innovations and implementation of EU Directives relating to this issue (primarily the EU Framework Directive on Waste, Council Directive 75/439 / EEC on the disposal of waste oils, Council Directive 91/689 / EEC on hazardous waste). By ratifying these directives, our country has accepted the obligation to regulate the area of waste management, which involves primarily a series of institutional reforms, improvement and harmonization of legislation in the waste management sector and the introduction of certain financial instruments (primarily subsidies as well as regular payment thereof) which should to serve the realization of defined goals.

The paper presents the possibilities of treatment equipment and oil-contaminated parts as well as their transformation into harmless material, which significantly reduce the risk to human health and the environment. For these reasons, it is necessary to improve the knowledge and obtain information about the prevention and management of waste oils.

REFERENCES

[1] Madić B., Obradović Lj., Petković S., Urošević D., Upravljanje tečnim opasnim otpadom, PETp - Časopis Ecologica, Novi Sad, 15(2008)52, str.67-69.
[2] Mitrović J., Urošević D., Janković V., ISKORIŠĆENJE OTPADNIH ULJA, PTEP– Časopis Ecologica, Novi Sad, 12(2008)4, s.245-248.
[3] Nacionalna strategija upravljanja otpadom RS, Agencija za zaštitu životne sredine
[4] Pravlik o uslovima, načinu i postupku upravljanja otpadnim uljima, Službeni glasnik RS br. 71/2010
[5] Taylor Nelson Sofres Consulting: Critical Review of Existing Studies and Life Cycle Analyis on the Regeneration and Incineration of Waste Oil, 2001
[6] Recycling Possibilities and Potential Uses of Uses Oils, Regional Activity Centre for Cleaner Production (RAC/CP), 2000
[7] Zakon o upravljanju otpadom, Službeni glasnik RS br. 36/2009
[8] Radni plan postrojenja za ipravljanje otpadom, za projekat skladištenje i tretman opreme i delova kontaminiranih uljima, Jugo-Impex d.o.o. Niš, Avgust 2013

BIOGRAPHY

Danica Ćirić was born in Pirot, Serbia 1990. She graduated from Chemical-technological school in Leskovac, in 2009 and enrolled the undergraduate studies at the Faculty of Occupational Safety in Niš, where she obtained B.Sc. in Environmental Engineering. In 2014 she ended master academic studies at the Faculty of Occupational Safety and obtained master's degree in Safety Engineering.

UPRAVLJANJE ULJIMA KAO OPASNIM INDUSTRIJSKIM OTPADOM

Danica Ćirić

Rezime: *Upravljanje otpadnim uljima predstavlja jedno od nekoliko ključnih pitanja u oblasti zaštite životne sredine. Jedan od vodećih svetskih problema jeste kako upravljati opasnim otpadom, između ostalog i tečnim opasnim otpadom u koji se svrstavaju i otpadna ulja. Zbog sve veće količine ove vrste otpada, opravdana je zabrinutost kako upravljati otpadnim uljima bez ikakvog štetnog uticaja na životnu sredinu. Evidentni problem i nizak nivo upravljanja otpadnim uljima u našoj zemlji poslednjih godina, pre svega se ogleda u nepotpunoj zakonskoj regulativi u ovoj oblasti, a otpadno ulje se uglavnom nelegalno sagorevalo, prosipalo i odlagalo. Usvajanjem Direktive o otpadnim uljima i Zakona o upravljanju otpadom, stvoreni su zakonski okviri za upravljanje otpadnim uljem, a time se i otvara mogućnost investiranja, odnosno poslovanja u ovoj oblasti.*

Ključne reči: otpad, otpadna ulja, upravljanje, skladištenje, tretman.