

# RECYCLING WASTE VEGETABLE OILS

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## Abstract

With the increasing fast-paced consumption culture in the world, our resources are rapidly decreasing, and environmental pollution is increasing with the unconscious release of used products into nature. With the decrease in resources, the issue of raw material supply emerges as a serious problem. Among the products used, the most harmful products to the environment are the oils that we use both industrially and individually. Used waste oils must be recycled or disposed of in an environmentally friendly manner if they are not suitable for recycling. Unfortunately, 1 liter of waste vegetable oil damages exactly 1 million liters of drinking water, rendering it unusable. As a result of the mixing of waste vegetable oils with toxic properties into groundwater, clean water resources are polluted. Groundwater is a very important source of drinking water for all countries in the world. By reviewing the national and international literature on waste vegetable oils and their recycling, general and up-to-date information has been compiled, and this compilation study has been prepared by taking into account the current legal regulations. Throughout the study, it was aimed to raise awareness in order to leave a livable environment, a cleaner and healthier world for future generations, and some suggestions were developed and tried to be presented.

**Key Words:** Waste vegetable oils, recycling, biodiesel fuels

## 1. Introduction

Vegetable oil; corn, sunflower, soy, etc. Jul is the name given to the oils obtained from the seeds of plant varieties and which we usually use in cooking in our daily lives. Vegetable waste oil is the name given to all of the sedimentary vegetable oils formed in the vegetable pure oil refinery, the oils formed when the oils used in the machines become unusable, the oily soils and the frying oils we use at home. An estimated 1,500,000 tons of vegetable oil are used in the food industry in Turkey annually. It is estimated that approximately 350,000 tons of waste oil is formed from this oil (URL-1, 2018 & URL-2, 2015).

There are two types of waste cooking or frying oil: yellow and brown oil. The ingredients in the cooking oil may include animal fat, fish oil, or vegetable oil, depending on the food fried or cooked in it. Yellow oil contains less than 15% fatty acids and can be a low-cost potential for biodiesel production. In contrast, brown oil has a higher water content and free fatty acids (> 15%), which has a negative effect on biodiesel production (Adewale et al., 2015; Bilgin, 2019).

A significant amount of waste oil is produced every day in the world from homes, restaurants, food processing industries, and fast food restaurants, and the release of these oils into the environment causes environmental problems (Dogan, 2016; Othman et al., 2017; Bilgin, 2019). The harm caused by waste to the environment and human health has been proven today as a result of many scientific studies. In particular, due to the damage, it causes to the environment, the waste of used vegetable oil also damages human health along with the balance and life cycle in nature. For example, although it is not recommended to use vegetable oils used for frying repeatedly, they are sent to nature in ways such as pouring them into the sink, especially at home, because they become a waste state after a maximum of several uses. Waste channels that can be blocked with this not recommended method can lead to serious problems in waste networks (URL-1, 2018).

If vegetable oils become waste after use and are poured into the sink, serious problems occur in infrastructure systems, and consequences up to clogging of wastewater channels may be encountered in the following times. It is also a proven result that these wastes that pass through the channels and reach the wastewater treatment plant have a negative impact on the treatment efficiency of the treatment plant. Vegetable waste oils that reach the

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receiving environment without purification are; it reduces the amount of oxygen in the water, harm other living things in the environment, especially fish, and also prevent oxygen transfer by covering the water surface like a film layer due to its specific gravity and destroys underwater life (URL-3, 2022).

It is worth noting that vegetable oils (olive oil, sunflower oil, etc.) if it gets into nature as a result of the disposal, if it reaches the sewers, it goes under the ground with rainwater from here, causing it to mix and contaminate drinking water, but if it gets into the soil, it can also damage the structure of the soil. On the other hand, it is thought that in oil wastes that can also be mixed into the seas, every 1 liter of waste oil can contaminate about one million liters of clean water. In this case, it is necessary to aim to get rid of these wastes that directly or indirectly harm the environment and human health in appropriate ways (URL-3, 2022).

All the waste oils collected can become sources of bioenergy, which means that it provides us with resources to produce renewable energy. Biodiesel fuels obtained from these sources emit a rate of greenhouse gases than petroleum-based fuels, which not only eliminates the damage caused by these wastes to nature but also allows to reduce the higher damage of different sources. Vegetable waste oils in our country can be recycled by facilities that have an environmental license issued by the Ministry of Environment and Urbanization. In this way, it can be converted into shapes such as raw materials to be used in the soap and chemical industry, not only as fuel such as biodiesel (URL-3, 2022).

## 2. Areas of Use of Vegetable Waste Oils

Instead of disposing of vegetable waste oils, taking advantage of these wastes and ensuring that they are recovered in a way that will provide the highest benefit to both the environment and the person as much as possible is the most correct method. The issue of recycling, which we often hear about today and is of great importance for the future of the world, also offers us many useful options for managing waste oils. Thanks to recycling, it is possible to get rid of our waste oils and turn them into a benefit (URL-3, 2022).

Looking at the areas of use of vegetable waste oils, it should be noted that this is either “product recovery” (biodiesel, soap, feed oil, etc.) at recovery facilities that have received a collection license from the Ministry.) or “energy recovery” (incineration at facilities licensed from the Ministry).

The term biodiesel was originally used to describe unmodified vegetable oils that could replace diesel fuel. The industrial use of biofuels started in the 1880s (Salvi & Panwar, 2012; Bilgin, 2019).

In 1900, the French Otto Company exhibited a diesel engine powered by peanut oil at the World's Fair in Paris. The concept of biodiesel was first proposed by the Belgian scientist George Chavanne in 1937 and the first patent was obtained with the title “conversion procedure for the use of vegetable oils as fuel”. in the 1940s, along with some information on using vegetable oils as a fuel for a diesel engine, many countries in Africa began to produce products for energy self-sufficiency (Mahmudul et al., 2017; Dewangan et al., 2018; Bilgin, 2019).

The study of vegetable oils as fuels began in the USA and South Africa in 1978 and 1981, respectively. The methyl ester was produced from rapeseed oil in Germany and Austria in 1982, and a small pilot plant was established in Austria in 1985. Commercial production of methyl ester on a commercial basis was first started in Europe in 1990 (Demirbas, (2008a); Bilgin, 2019).

On the subject of vegetable waste oils and their evaluation in biodiesel production in Turkey; Karadirek (2008) by “biodiesel production from waste vegetable oil”, Aybastier (2010) “characterization and evaluation of waste vegetable oil in biodiesel production”, Kutluk (2013) “by Arrested lipase-catalyzed biodiesel production from waste vegetable oil”, the record (2019) by “biodiesel production from waste vegetable oil catalyzed by ionic liquid” and Somuncu (2020) “by on biodiesel production from waste vegetable oil with Aspen hysys dynamic simulation of a reactive distillation column titled” is remarkable in the fields of academic studies thesis.

The use of biofuel or vegetable oil in internal combustion engines was tried and tested during the 1920-1930 and the Second World War. In particular, Germany, Argentina, Japan, Belgium, Italy, France, Great Britain, Portugal, and China have tested and used different types of biofuels. But due to the fact that the costs of petroleum-based fuels are lower, these studies it has slowed down. But recently, both environmental problems and the fact that fossil fuels will run out due to concern, biodiesel production has gained momentum again. Because biodiesel is a good alternative fuel candidate (Talebian-Kiakalaieh et al., 2013; Bilgin, 2019).

Vegetable oils cause some problems when they are used directly in diesel engines. Some common problems are the formation of carbon residues, clogging of fuel pipes, gelling of lubricating oils, and contamination of piston heads. Vegetable oils have a higher yield and cloudiness point than diesel fuels. Therefore, it is not recommended to use it in winter. Also, vegetable oils have a very high cetane number, which reduces the ignition delay. In October, they have a high iodine value, which increases the rate of oxidation. Therefore, it is not recommended to store such fuels for a long time (Joshi & Pegg, 2007; Demirbas, (2008b); Bilgin, 2019).

As for the production of soap and feed oil from waste oils, the recovery facilities obtain the necessary permits from the relevant Ministries. The necessary permits for the production and use of products other than these are obtained from the relevant institutions within the framework of meri legislation. Recovery products and semi-finished products that have not been set as a standard are not used as final consumption items. Since the used vegetable oils have a very high-calorie content, they can be used for the preparation of animal feed. Before such waste oils are used as animal feed, the amount of "PCB", "PAH", "furan", "dioxin" and "dioxin-like substance" in the waste oil should be determined. In order to increase the calorie content of animal feed and to serve as a binder, a certain proportion of used vegetable and animal fat wastes is used (URL-2, 2015).

In 2006, Uluçay conducted a study entitled "A Model Trial for the Management of Vegetable Waste Oils in Turkey". Şahinoğlu, on the other hand, conducted research on "The Availability of Vegetable Waste Oils and Transonic Waves in the Cleaning of Coal by the Method of Oil Agglomeration" in 2012.

The study conducted by Özdemir (2021) titled "Evaluation of Vegetable Waste Oils and Waste Newsprint Fibers in Waste Polypropylene Composites" is also a remarkable example in its field.

### 3. General Principles for the Control of Vegetable Waste Oils in Turkey

06.06.2015 by date and 29378 published in the Official Gazette "regulation on control of waste vegetable oil", until the disposal of waste vegetable oils, without harm to the environment and human health management for the provision of the necessary technical and administrative management standards for the establishment of principles, rules, and procedures for the determination of policies and programs organized. The information on the general principles established for vegetable waste oils is presented in the following articles (Official gazette, 2015):

- a) Import of vegetable waste oils is prohibited. The rules for its export and transit are governed by the provisions of the Waste Management Regulation.
- b) Reduction, separate collection, and recovery of vegetable waste oils at the source is essential. Vegetable waste oils that are not suitable for recycling are disposed of in accordance with the provisions of this Regulation.
- c) It is forbidden to mix vegetable waste oils directly or indirectly into cooking oils and crude oils.
- d) It is essential that vegetable waste oils are collected separately at the source and stored accordingly.
- e) The institution, organization, or enterprises producing vegetable waste oil are obliged to conclude an annual contract with environmentally licensed recycling facilities or intermediate storage facilities Dec vegetable waste oil for the collection of these oils.
- f) It is essential to clean the Decanted collection containers, tanks, and containers in recycling facilities or in vegetable waste oil intermediate storage facilities.
- g) Vegetable waste oils are collected by environmentally licensed recycling facilities and vegetable waste oil Decommissioning facilities. Vegetable waste oils cannot be collected by natural and legal persons other than this.
- h) Vegetable waste oils can only be used in the production of biodiesel and biogas in accordance with the relevant technical regulations.
- i) Vegetable waste oil producers within the scope of subparagraph (e) of this article are obliged to inform the relevant provincial directorate of any disputes that may arise from a violation of the contract they have concluded with Decontamination or intermediate storage facilities for vegetable waste oil.
- j) An enterprise that provides food services for vegetable waste oils that will be caused by enterprises that provide food services within the framework of another institution or organization is considered a producer of vegetable waste oils.
- k) Vegetable waste oil producers, collectors, carriers, and recovery and disposal companies are jointly and severally liable for the damages caused by environmental pollution and degradation caused by vegetable

waste oils. The responsible persons are responsible for compensation in accordance with the general provisions for damages caused as a result of these activities.

- 1) The cost of remedying environmental damage arising from the management of waste oils vegetable 2872 by the Environmental Act according to the polluter pays principle will be paid by the real and legal persons responsible for waste management. The persons responsible for the management of waste vegetable oil to stop environmental damage, and reduce the necessary measures to avoid or resolve these measures and due to be taken by the competent authorities of the necessary expenditures directly to public institutions, the law on collection procedure of public receivables 21/7/1953 dated 6183 no according to the provisions of the ones responsible for the management of waste vegetable oil are charged.

#### 4. Stakeholder Obligations

What are the obligations of the stakeholders according to the relevant articles of the “Regulation on the Control of Vegetable Waste Oils” published in the Official Gazette dated 06.06.2015 and Numbered 29378 are presented below:

##### 4.1. Obligations of Producers of Edible Vegetable Oils

Manufacturers of edible vegetable oil;

- a) On the labels of vegetable oil packages, “Do not pour vegetable waste oils into the sink or into receiving media such as water, soil. by including the phrase ”,
- b) To inform the Ministry of the quantities of vegetable oils released to the market by the end of March of the following year to include the data of the previous year,
- c) Supporting public education and awareness-raising activities for the purpose of regular collection of vegetable waste oils,
- d) in cooperation with the municipalities, the Ministry of amounts designated for the collection of waste vegetable oil from households with set up the necessary systems, manufacturers what they build together for the organization receiving authorization from the Ministry of vegetable waste oil collection, waste management plans of the ministry, with the option to presenting the annual report of the Ministry of these activities,
- e) Obtaining authorization from the Ministry and fulfilling the authorized organization obligations within the framework of the provisions set Dec in Article 21 of the Waste Management Regulation for the organization of vegetable waste oil collection that producers will gather and establish together, they are obliged to.

##### 4.2. Obligations of the Producer/Owner of Vegetable Waste Oil

Vegetable waste oil manufacturers;

- a) Storing vegetable waste oils separately from other waste materials and garbage,
- b) Excluding residential buildings;
  - 1) Using sealed, corrosion-resistant collection containers with internal and external surfaces for the accumulation of vegetable waste oils formed as a result of their activities,
  - 2) Sending vegetable waste oils to processing plants with licensed carriers,
  - 3) They are obliged to use the national waste transportation form for the shipment of vegetable waste oil.

January Marching year, starting from the end of March at the latest, vegetable waste oil producers under Article 5 (e) are obliged to fill out, approve, print out and keep a copy of the waste declaration form by using online applications prepared by the Ministry for five years, including information from the previous year, by the end of March.

##### 4.3. Obligations of Plant Waste Oil Recovery Plant Operators

Vegetable waste oil recovery plant operators;

- a) Obtaining environmental permits and licenses from the Ministry,

- b) Sending annual reports on its activities to the relevant provincial directorate by the end of February,
- c) To determine the acceptance criteria of vegetable waste oil to the plant, to determine the conformity of vegetable waste oil to the waste definition specified in the national waste transportation form,
- d) To ensure the recovery of vegetable waste oils accepted to the plant within three months,
- e) To dispose of vegetable waste oils that cannot be recovered within the period of,
- f) To register for online programs and prepare mass-balance information containing information about the wastes accepted, processed, and created as a balance at the facility and the products created/produced as a result of waste processing activities, and to notify using the online program,
- g) Obtaining an environmental license from the relevant provincial directorate for vegetable waste oil Decommissioning facilities that will be established outside of recovery facilities for the collection of vegetable waste oils,
- h) Storing vegetable waste oils accepted to the plant separately,
- i) To provide training to its personnel in the nature required by the recovery activities, to prepare emergency plans, to keep business records related to waste management, and to keep these records at the facility for five years,
- j) Disposal or transportation of wastes and materials contaminated with them arising as a result of recovery operations in environmentally licensed facilities, covering expenses related to this,
- k) Notifying the relevant provincial directorate of the cancellations of the contract with the vegetable waste oil Decommissioning facilities no later than one month,
- l) Preparing the fire brigade project and obtaining permission from the relevant municipality, are obliged.

#### 4.4 Obligations of Vegetable Waste Oil Decommissioning Facilities

Vegetable waste oil Decommissioning facilities;

- a) Obtaining a license for Decommissioning vegetable waste oil from the provincial directorate,
- b) By entering into a contract with recovery facilities, submitting this agreement to the provincial directorate when applying for Decommissioning permits for vegetable waste oil,
- c) Not storing vegetable waste oils for more than three months, taking into account the recovery processes,
- d) To provide Jul bins and containers to the vegetable waste oil producers they have contracted with,
- e) To inform the relevant provincial directorate of the amount of vegetable waste oil collected and shipped to the recovery facility on a monthly basis,
- f) To inform the relevant provincial directorate about the disputes and contract cancellations that will arise with the recovery company within one month at the latest,
- g) Obtaining permission from the relevant municipality by preparing the fire brigade project, they are obliged to.

#### 5. Conclusion and Recommendation

As a result, as can be seen from all of this information compiled and presented above, groundwater and soil will be protected and kept clean thanks to all the collection and evaluation studies to be carried out for vegetable waste oils in Turkey. Otherwise, if these oils are spilled into the environment in an uncontrolled, unauthorized and unconscious manner, they will cause great damage to the soil and the environment and a great harm will be done to the heritage of our future generations. The recommendations that were filtered and developed as a result of the study are presented in the following articles:

- ✓ Published in the official gazette of the “regulation on control of waste vegetable oil”, until the disposal of waste vegetable oils, without harm to the environment and human health management for the provision of the necessary technical and administrative management principles for the establishment of standards, policies, and programs are arranged in relation to the determination of principles and procedures which must be complied with. Compliance with these rules should be checked by a strict control mechanism.
- ✓ In order to raise awareness and inform people about the collection of waste oil in the region, teams should be formed and meetings should be held in December at certain intervals.
- ✓ Waste oil assessment, collection, etc. by public institutions or organizations such as the Ministry of Environment and Urbanization and Municipalities are included in the projects to be developed by the relevant Faculties and Departments of these Universities. budgets and support can be provided on issues

- related to activities. There are also good examples of applications where municipalities in some regions support the collection of vegetable waste oils, and support the removal of waste oils by going to homes.
- ✓ The stakeholder obligations mentioned above and the framework of which has been determined by law must be strictly complied with by the relevant stakeholders. Personally, we use the vegetable oils that have become waste oil in our homes, containers such as pet bottles, with their mouths tightly closed, to the waste oil collection point closest to us (head offices, waste collection centers, etc.) we can leave it.

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