ISCC GUIDANCE
WASTE AND RESIDUES FROM FOOD AND FOOD PROCESSING

Used Cooking Oil, Brown Grease, Soapstock, Food Waste, Sewage Sludge, and Spent Bleaching Earth

Version 1.2

Document Title: ISCC Guidance on Waste and Residues from Food and Food Processing

Version 1.2 DRAFT

Valid from: DRAFT

Content

Summary of Changes

The following is a summary of the main changes to the previous version of the document (v 1.0). The revision of the document covers additional feedstocks added to the document. Minor amendments, e.g. corrections of phrasings and spelling mistakes, are not listed.

Summary of changes made in version 1.1	Chapter
Addition: Guidance on Spent Bleaching Earth	3.2.2

1 Introduction

Need for waste and residue specific guidance

Waste and residue feedstocks are a privileged group of materials with specific legislation in place to encourage their use in the production of biofuels. This document sets out definitions for specific waste and residue materials as well as additional information on the places where these substances accumulate and other considerations for auditors.

2 Scope and normative references

Feedstock-specific information is presented

The contents of this guidance focus on points of origin and collecting points for waste and residues feedstocks. Topics like the properties of the waste and residue feedstocks, supply chain elements involved and points to consider for plausibility are described. This document has been developed through a multi-stakeholder ISCC working group on wastes and residues involving members of the ISCC Association (companies and industry associations with expertise in this topic), certification bodies and auditors. This document supplements the ISCC EU system document 202-5 Waste and Residues in its currently applicable version as published on the ISCC website. The document will be reviewed and updated periodically.

3 Feedstocks

Specific annex IX materials are addressed

This section contains detailed information on a selection of waste and residue feedstocks listed in Annex IX of the Directive (EU) 2023/2413. Materials covered in this document will be expanded through ongoing consultation with members of the ISCC working group on waste and residues. Feedstocks have been selected on a risk basis and through discussions of the above-mentioned working group.

Feedstocks covered by this document include: Used cooking oil, Brown Grease, Soapstock and Soapstock acid oil, Food Waste, Sewage sludge, and Spent Bleaching Earth.

3.1 Used cooking oil

3.1.1 Definition

Used cooking oils (UCOs) are oils and fats of vegetable or animal origin that have been used in the cooking, frying, preparation, or preservation of food for human consumption. This may also include fats and oils that naturally render out of food and unavoidably mix with the cooking oil during the cooking process. Food preparation includes marinating, whereas preservation involves methods like pickling and canning foods in fats or oils.

Wastes from other uses of cooking oil, such as lubrication of food processing machinery, may be classified as used cooking oil, so long as this is not contrary to any local regulation of such practices, for example where there is a specific waste management process for such a waste.

Specification of UCO from vegetable or animal origin

UCO may originate from vegetable oils, animal fats or a mixture of both. It may be specified that it is entirely of vegetable origin, or partly or entirely of animal origin. UCOs are treated as waste under the RED III and are widely accepted as waste by EU Member States with some restrictions. For example, Germany only accepts UCO entirely of vegetable origin[1]. In cases where vegetable fats or oils are used to deep-fry animal products (e.g. when cooking fried chicken), the resulting UCO may contain unavoidable "contamination" with animal fats or oils. Under these circumstances, it still qualifies as UCO of vegetable origin and the biofuel produced from this UCO can still be counted towards the German quota obligation[2].

Other names for UCO

UCO is a waste if it is considered no longer fit for the purpose of cooking food for human consumption. UCO is listed in Annex IX part B of the RED III and thus may qualify for double-counting but does not qualify as "advanced".

Used cooking oil may also be known by other names such as:

- Used vegetable oil
- Waste vegetable oil
- Waste cooking oil

In the United States 'yellow grease' is a term used to refer to a mixture of UCO and animal fats. Also, one shall distinguish waste vegetable oil from expired vegetable oil that are to be discarded because of their unsuitability for human consumption.

3.1.2 Target biofuels

Several biofuel target paths

UCO is a suitable feedstock for biodiesel, hydrotreated vegetable oil (HVO), and other processes capable of hydrogenating esters and fatty acids. It may also be suitable for co-processing with fossil feedstocks.

3.1.3 Chemical and physical properties

Fresh cooking oils are composed mostly of triglycerides. These oils are obtained from many different sources and modified using a multitude of different processes, for example by pressing and purifying vegetable oil seeds. Other methods, such as solvent extraction and hydrogenation, are also used in the industry to extract and modify vegetable oils. Please also note that some oils, like olive oil and coconut oil, come from the fruit or nut of the plant rather than the seed. Furthermore, the term "purifying" can encompass various processes beyond pressing, including refining, bleaching, and deodorising, which are commonly employed to enhance the quality and stability of the oil.

Differentiating UCO from virgin oil

UCOs share the main characteristics of the virgin oil from which they were derived, however the cooking process changes their chemical and physical properties. In general, UCO will be darker colored and stronger smelling than

[1] According to paragraph 37b(8) Nr. 3 Federal Immission Control Act (Bundesimmissionsschutzgesetz - BImSchG)

[2] According to Article 9 paragraph 3 of the 36. BImSchV

the virgin oil from which it is derived. It will also have higher free fatty acid (FFA) content, as well as changes in other trace markers such as polar compounds other than FFAs (e.g. mono- and diglycerides), and sulfur and nitrogen containing compounds.

Impact of religion and culture on UCO properties

Religion and culture have an impact on cooking styles and the types of oil used in different regions. These factors influence the physical and chemical properties of the UCO collected in that region. For example, the use of cooking oil to fry food is more prevalent in Mexican and Chinese cultures than in Japan. Besides religion and culture, the cooking process itself also influences the physical and chemical properties of the UCO. If the process involves food with a high moisture content, or the same oil is used repeatedly, or heated and cooled frequently, it will degrade the oil further and increase the content of FFAs, sulfur, nitrogen, moisture, and other impurities.

FFA limits of UCO for biodiesel production

Some biodiesel producers will have a limit for FFA content in oils that they can process. Strict limitations on FFA content are most relevant to biodiesel producers. HEFA/HVO facilities may be able to process higher FFA content. If used as a feed in a co-processing facility, there is almost no limit on the FFA content due to the small amount of biocomponent mixed into the fossil feed. Although HVO and co-processing can tolerate high free fatty acid content, a low metal content is essential to maintain catalyst longevity. Thus, the use of UCO usually necessitates pre-treatment for large-scale applications. Collecting points may measure FFA content. This is typically done using titration against a standard.

3.1.4 Description of point of origin

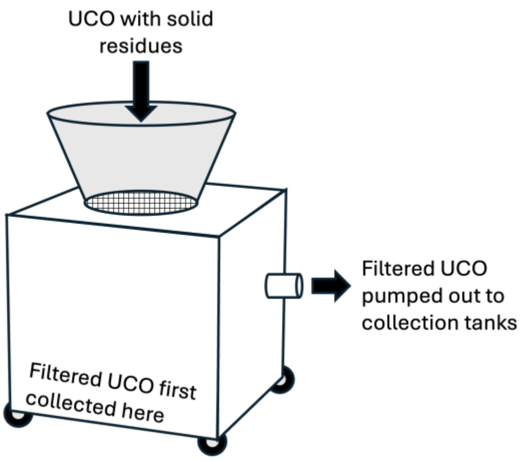
UCO is predominantly collected from three types of points of origin (PoO):

- Food and beverage outlets, such as restaurants, hotels, and hospitals
- Industrial and communal food processing facilities; and
- Municipal collecting facilities serving household kitchens

Various points of origin for UCO

Food and beverage outlets include all kinds of restaurants, fast food chains, cafeterias, and catering services, including those in bigger venues such as stadiums and hospitals. Industrial food processing facilities are factories which process food through frying or cooking to sell in supermarkets or other food outlets. Household kitchens may also be points of origin for UCO in some countries.

In a restaurant or food processing facility, UCO can be collected either directly from friers or pans, or by using a dedicated oil filter that removes solids.



Exclusion of Brown Grease

Oils and fats that collect in a grease trap below a sink are not considered UCO – see Brown Grease.

Collecting points for UCO

A Collecting point (CP) is a central location where UCO from multiple points of origin is collected. It may be collected from PoOs in small containers before being combined into larger tanks or purification units at the CP. The PoO shall keep a record of the quantity of oil collected by or transferred to a CP. As well as private collection points for UCO, in some regions there are also public collection points installed by municipal authorities.

Collection of UCO from households is done via a municipal facility or waste management company. Such collecting facilities should keep a record of the geographic area served. UCO collected by or from households as a segregated waste stream should be classed as UCO (Annex IX, Part B.) and not Biowaste (Annex IX, Part A. (c)).

3.1.5 Description of collection practices

The predominant arrangement for UCO collection is one where an organisation visits many PoOs, collecting the UCO in small batches that are aggregated at a central collecting point. Other arrangements exist, such as:

Different scenarios for collection of UCO

- The biofuel producer sets up a door to door collecting system to collect directly from the PoOs of UCO.
- PoOs of UCO deliver it to centralised collection points. The biofuel producer collects the UCO directly from these locations.
- The collecting point or biofuel producer supplies the virgin vegetable oils or animal fats to the PoO of UCO and collects it for recovery after use.

3.1.6 Guidance on assessing plausible yields

Considerations for yield plausibility

It can be challenging to assess whether the quantity of UCO produced at a particular location is plausible. This requires careful consideration of the type of PoO, the type of waste, the material it is derived from, and any other wastes associated with the parent material. The comments below should be treated as a guide for audits, however auditor discretion will be required in each individual case.

The amount of UCO that accumulates in a particular PoO will be related to the following factors:

- The quantity of virgin oil acquired and used at the PoO in the period between collections
- The type of cooking or preparation done at the PoO
- The waste management practices at the point of origin

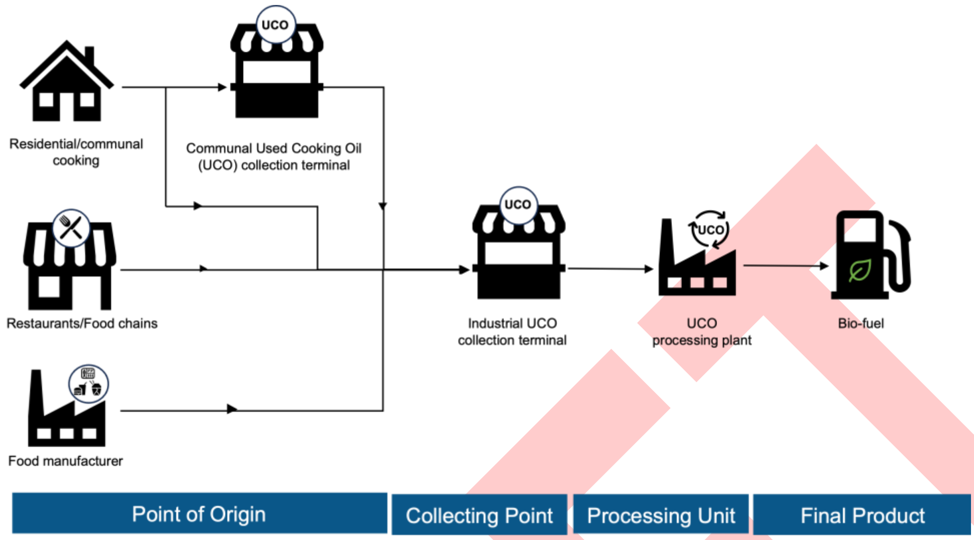
To provide a representative overview of monthly UCO generation, the following analysis focused on average yields from three categories of PoOs: Restaurants, chains (e.g. fast food chain), and local collection points. Further, company data from selected European, African and Asian countries was used to calculate the average values. Note that these numbers are based on monthly average yields that may vary depending on the specific type of PoO, the frying oil used and the collection practices.

Incurred losses at collecting point

It is important to note that, if purification of the oil is taking place at the collecting point, this will incur losses. The size of these losses will depend on the quality of oil collected from PoOs and the purification practices employed by the CP. ISCC System Users and literature[3] suggest that from 100 kg of crude UCO approximately 10-30 kg could be impurities such as solids and water.

[3] Cárdenas, J., Orjuela, A., Sánchez, D. L., Narváez, P. C., Katryniok, B., & Clark, J. (2020). Pre-treatment of used cooking oils for the production of green chemicals: A review. Journal of Cleaner Production, 289, 125129. https://doi.org/10.1016/j.jclepro.2020.125129

3.1.7 Example supply chain



3.1.8 Audit considerations

High risk audit

Under ISCC EU, the risk level must always be high for all audits (certification and surveillance audits) of individually certified Points of Origin, Collecting Points, and Central Offices that handle waste/residues from processing of animal or vegetable oils / soapstock, food waste, POME oil, brown grease/grease trap fat, sewage sludge and/or UCO. General and specific requirements as listed in the document ISCC EU 203 – Traceability and Chain of Custody forms the basis of audit requirements for different supply chain elements handling wastes and residues. Having said that, the following are the considerations for auditors to check specific aspects in UCO supply chains.

3.1.8.1 Point of Origin

Type of points of origin

Auditors shall consider the type of point of origin for the UCO; is it from food and beverage services, kitchens, or food processing facilities? Another important aspect to be checked is type of oil used and how much is used. Auditors can retrieve this information from inventory invoices, oil change/oil refill rate. Auditors shall check the origin of virgin oil, whether it was an animal or vegetable oil. PoOs shall be audited on-site on a sample basis.

3.1.8.2 Collecting Point

On-site audit of collecting points

Collecting points must be audited on-site. Auditors shall assess bookkeeping of wastes and shall assess the correct classification of the waste material according to its chemical and physical properties. Auditors should inspect any documentation relating to analysis of volumes and type of incoming or outgoing materials. The equipment and record keeping for measuring the mass of incoming and outgoing materials should be checked for inconsistencies, such as unusually round numbers and regular "patterns" in the documentation (e.g. sequence of numbers, timing of deliveries). Any purification steps (e.g. removing residues, control of free fatty acids content) should be assessed for their suitability for handling the types and qualities of material received from PoOs. Storage facilities for waste materials shall be separate from, or different to, those used for non-waste materials for the physical segregation approach.

3.1.8.3 Processing Unit, Biodiesel or HVO plant

Ensuring correct documentation and material declaration

At this stage of the supply chain, the auditor must check the correct documentation and mass balancing of the UCO that is being processed. In addition to this, auditors may check any certificate of analysis available including product description of UCO. These certificates might help an auditor to check quality of incoming material and if the material is correctly declared or not. Wrong declaration of material is considered a critical non-conformity and leads to the immediate withdrawal of a certificate. Entities shall be informed of the ISCC's strengthened requirements for waste and residue supply chains effective since 1st of August 2023.

3.2 Brown Grease

3.2.1 Definition

Boundary for brown grease/ grease trap fat

Brown grease / grease trap fat (BG) is defined as oil, fat and grease that is recovered from grease traps below sinks or in drainage systems. It is often a mixture of water, oils, fatty acids, and sediment. A grease trap is designed to prevent these contaminants from clogging sewage piping. BG is generally removed by specialised collection service providers and disposed of in landfills or wastewater treatment plants.

Material removed from the publicly owned sewage system shall not be reported under this category.

By definition, brown grease accumulates in the presence of water. This has implications for how it can be collected, the chemical and physical properties of the material, and hence the processes required to turn it into a fuel.

Properties of brown grease

While compounds suitable for the production of FAME or HVO are present, the highly contaminated and low-quality nature of BG can lead to higher processing costs in comparison to UCO due to the requirement for pre-treatment in the form of dewatering (sometimes up to 85% water content) and filtration/separation.

Brown grease refers to the complete portion of the grease trap that is removed by the collector.

3.2.2 Target Biofuels

Several biofuel target paths

The lipophilic portion of BG may be a suitable feedstock for biodiesel (esters of fatty acids, such as FAME), hydrotreated vegetable oil (HVO), and other processes capable of hydrogenating esters and fatty acids. It may also be suitable for co-processing with fossil feedstocks. The aqueous and solid fractions of BG may be a suitable feedstock for biogas production. It may also be possible to use the whole content of the grease separator, i.e. untreated BG, as feedstock for biogas production.

3.2.3 Chemical and physical properties

Characterisation of brown grease

Grease traps are designed to separate water and grease. As such, brown grease accumulates in wet environments and the glycerides that make up the oil fraction will be subject to hydrolysis. This means that oily fraction of brown grease collected from a restaurant would likely have a higher free fatty acid (FFA) content than a UCO collected from the same location.

Brown grease can take a range of forms but is generally a mixture of oils, fats, water, and sediment. It is usually contaminated with other food residues and surfactants used for cleaning.

3.2.4 Description of point of origin

Points of origin for brown grease are grease traps. Grease traps, sometimes referred to as grease separators, are devices designed to reduce the amount of fat and grease entering the sewage system. A grease separator could be installed under the sink in the PoO (e.g. restaurant) or set outside the building.

Exclusion of materials from public sewage system

These may be located on the premises of restaurants or food processing units, or they may serve several different wastewater producing sites. In each case the point of origin is defined as the responsible legal entity within whose boundaries the grease separator is located.

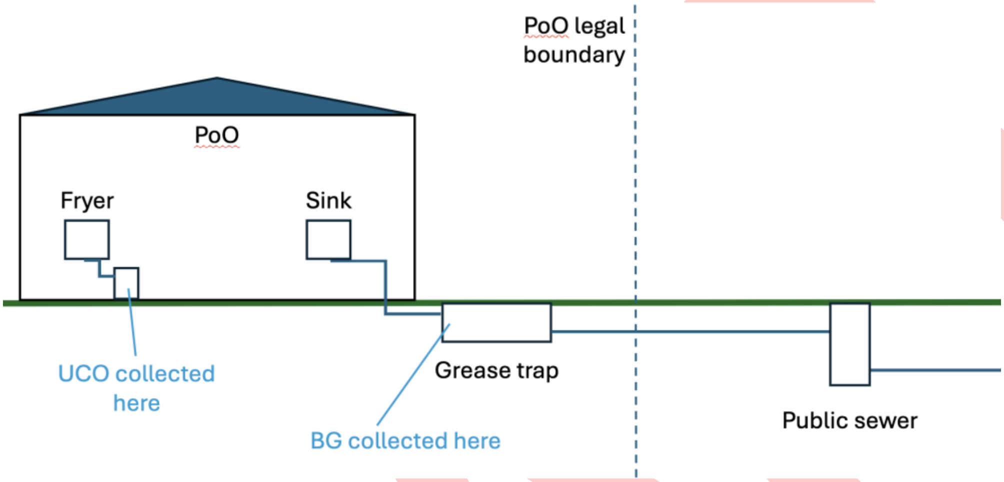


Image taken from https://grease-cycle.com/blog2/how-does-a-grease-trap-work

Material removed from the sewage system shall not be reported under this category.

3.2.5 Description of collection practices

Specialised extraction and collection

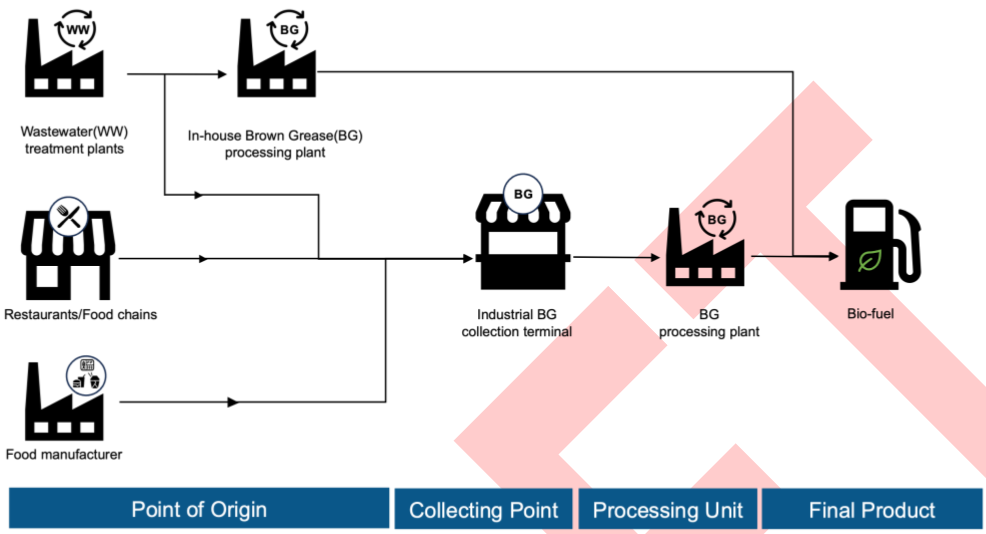
The collection arrangements for brown Grease may be similar to those of UCO, however extracting the material from separators requires specialised equipment. Due to the heterogeneous nature of the material, it will generally be taken from the PoO to specialised processing plants or pre-treatment plants. These specialised processing or pre-treatment plants dewater the brown grease through heating and decanting processes.

3.2.6 Guidance on assessing plausible yields

Yield dependent on collection process

Yields of material suitable for fuel production after treatment processes vary greatly depending on the exact nature of the brown grease collected. Some facilities report that, from the brown grease removed from a separator, approximately one percent treated brown grease can be obtained, others report up to 10%. The proportion of oils and fats in collected BG will depend on the collection practices employed. If the whole content of the grease separator is removed, including fats, water and sediment, then the proportion of fats, oils and greases may be low.

3.2.7 Example supply chain



3.2.8 Audit considerations

Separate mass balance for UCO and BG

Disposal and processing of grease separator contents must be carried out separately from UCO collection. Auditors shall check if UCO and BG are kept separated in the mass balance.

Verification of grease trap

The sources of the grease trap contents should be randomly sampled, and the specialised treatment plants/processing units should be audited.

The ratio of the treated grease trap content to the separated quantity of brown grease must be verified by the specialised treatment plants.

High risk audit

Under ISCC EU, the risk level must always be high for all audits (certification and surveillance audits) of individually certified Points of Origin, Collecting Points, and Central Offices that handle waste/residues from processing of animal or vegetable oils / soapstock, food waste, POME oil, brown grease/grease trap fat, sewage sludge and/or UCO. As for UCO, general and specific requirements listed in the document ISCC EU 203 – Traceability and Chain of Custody forms the basis of audit requirements for different supply chain elements handling brown grease as well.

3.3 Soapstock and Soapstock acid oil

3.3.1 Definition

Soapstock emerges from the processing of vegetable or animal oils. Under ISCC it may be certified as "Soapstock" with a specification of the raw material or crop in brackets.

Chemical composition of soapstock

Soapstock consists of the alkaline salt of fatty acids (soap) and other substances from the processed oil such as free fatty acids, (phospho)glycerides, and other impurities emulsified in water forming a sludge-like material. The presence of alkaline in the process is essential for the formation of soapstock.

Recovery of Soapstock acis oil

It is possible to recover an acid oil (so called soapstock acid oil) from soapstock via so called soapstock splitting. This acid oil contains fatty acids which can be used to produce biofuels. The acid oil shall be certified as "Soapstock acid oil" (not "Fatty acids") or "Soapstock acid oil contaminated with sulphur". The latter is consistent with the UK positive list and shall be applied if the final fuel is destined for the UK market and the contamination criteria are met, i.e. the soapstock acid oil is not suitable for applications other than energetic recovery due to the contamination with sulphuric or phosphoric acid.

3.3.2 Target biofuels

FAME and HVO as target fuels

Soapstock acid oil is a suitable feedstock for biodiesel (esterified fatty acids like fatty acid methyl esters, FAME) or renewable diesel (via hydrogenation to hydroprocessed esters and fatty acids, HEFA). It may also be suitable for co-processing with fossil feedstocks.

As some biodiesel producers have a limit for the FFA content, soapstock acid oil may also be mixed with oils that have a lower free fatty acid content.

3.3.3 Chemical and Physical properties

Characteristics of Soapstock

Soapstock is a viscous, semi-solid to paste-like material varying in color from dark brown to yellow with strong, fatty odor. It has emulsifying properties due to its soap-like character, but it is only soluble in organic solvents not water. Soapstock does not have a defined melting point due to its complex mixture, but it softens significantly at around 30–50°C. Higher temperatures can lead to decomposition and off-odors, especially when water content leads to hydrolysis of fatty acids. Due to alkali residues pH ranges 8-10 depending on washing and neutralisation steps.

Soapstock may react with acids releasing an acid oil that contains fatty acids and is known as soapstock acid oil.

3.3.4 Oil refinery as point of origin

Soapstock emerges during neutralisation

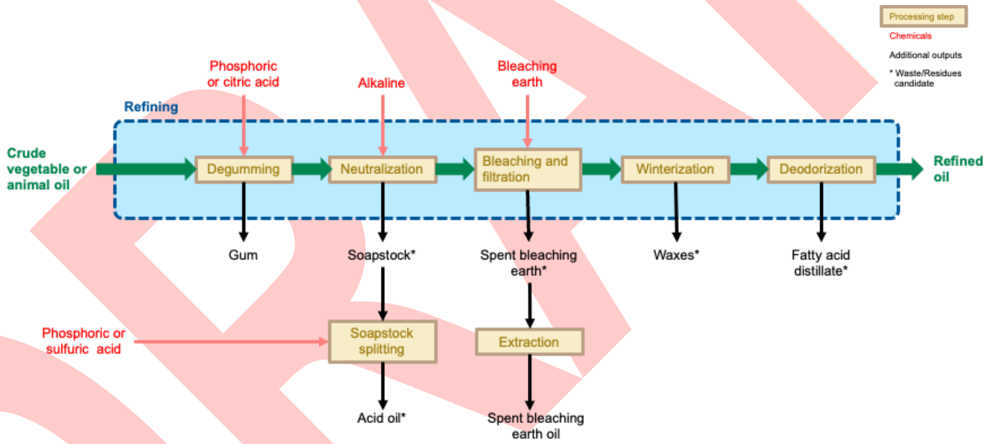
Soapstock is formed when alkaline reacts with fatty acids or their esters like oil (glycerin ester). Such an alkaline treatment is typically done in oil refineries or biodiesel plants to neutralise the oil. The neutralisation aims to remove the free fatty acids chemically via the formation of soapstock.

Crude vegetable or animal oils contain oils / fats (triglycerides of fatty acids), free fatty acids and phospholipids (phosphoglycerides). Depending on the input oil different refinement options exist:

- Soft oils (rapeseed, sunflower, soy) are typically chemically refined by adding chemicals to facilitate separation processes
- Hard oils (palm oil, coconut oil) are typically physically refined e.g., by distillation without additional chemicals to facilitate the separation

Process steps in refineries

While a refinery might process soft and hard oils, they are typically segregated. Soapstock will only be produced during chemical refinement upon neutralisation with alkaline. The following figure illustrates the different process steps and indicates the generated materials at a vegetable/animal oil refinery. Note that this is only an illustrative example, i.e., not all steps might occur at an individual refinery.

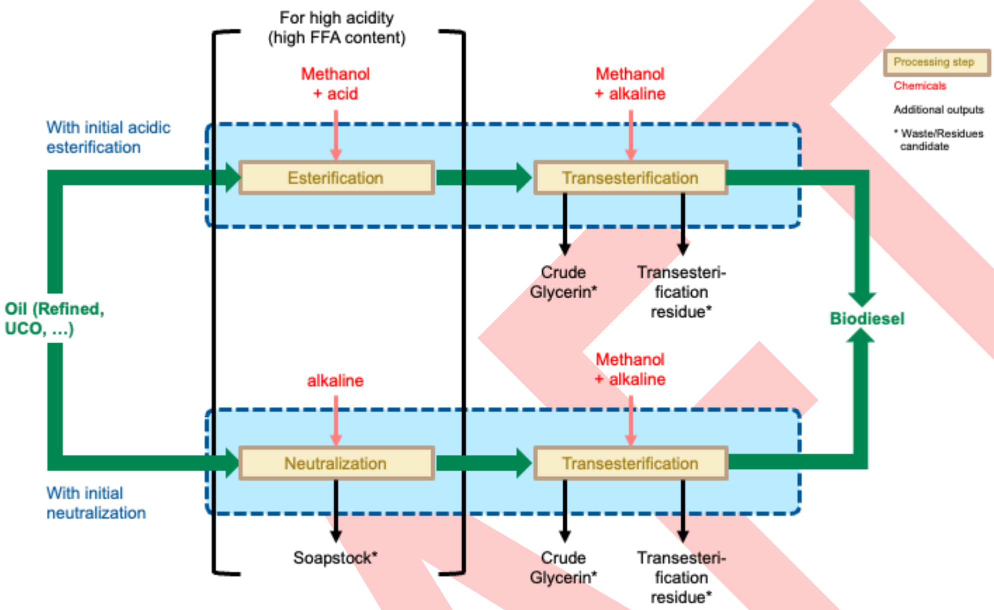


Soapstock emerges from the neutralisation step, where alkaline is added to the oil. The treatment of soapstock to form its acid oil ("soapstock acid oil") may happen at the refinery or a dedicated treatment plant.

3.3.5 Biodiesel plant as point of origin

Biodiesel plants may do neutralisation as pretreatment

Soapstock may also be formed at Biodiesel plants. Depending on the acidity of the used feedstock a pre-treatment may be conducted to reduce the free fatty acid content. This pre-treatment might be esterification or neutralisation. The latter is similar to neutralisation in a refinery and therefore leads to the formation of soapstock. The following figure illustrates the different process steps / routes and indicates the generated materials at a biodiesel plant. Note that the transesterification residue, which is generated during the transesterification step in the biodiesel plant, also contains some alkaline salts of free fatty acids (soap). However, the composition of this phase is different compared to soapstock and should thus be referred to as "transesterification residue".



3.3.6 Description of collection practices

Soapstock splitting may be done at different locations

Soapstock may be treated via the so called "soapstock splitting" to recover the fatty acids but also to simply split the emulsion into a water and oil phase. It might therefore be part of the waste treatment at the point of origin (e.g., a refinery). However also an external waste treatment plant might conduct this treatment.

The recovered soapstock acid oil may also qualify as waste or residue if one of the following conditions is met:

- The soapstock splitting is done as part of a waste treatment arranged by the refinery. An external facility might do the same process but with the intention to recover the acid oil and thereby generating a more valuable material instead, which disqualifies the obtained material from being a waste/residue.
- The final fuel is destined for the UK fuel market and meets the definition of "soapstock acid oil contaminated with sulfur" according to the UK positive list.

3.3.7 Guidance on assessing plausible yields

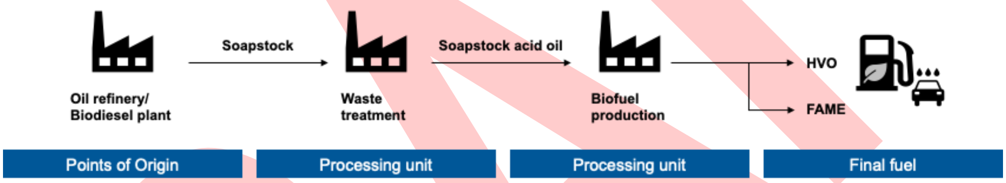
Soapstock yields depend on the type of oil

At an oil refinery soapstock yields (including water etc.) ranges typically from 3% to 8% of the crude oil. The yield depends on:

- Quality of crude oil: Higher impurity levels in crude oil leads to higher soapstock volumes
- Type of oil and refining process: Softer oils undergoing chemical refining using alkaline leads to soapstock whereas physical refining of harder oils does not give rise to soapstock

At a biodiesel plant soapstock yields are typically below 1% of the input given that the oil is often already refined and has thus lower FFA content. However, for an FFA rich feedstock like UCO, soapstock yields may be up to 5%.
The fatty acid content of soapstock is typically ranges from 10 to 35%, which is then the yield expected for the recovered of soapstock acid oil.

3.3.8 Example supply chain



3.3.9 Audit considerations

Refineries as point of origin must be certified individually.

PoO and labelling needs to be considered

As for the recovered soapstock acid oil the auditor shall ensure that the waste status is justified as it is produced as part of the refinery's waste treatment or/and is contaminated. Please note that soapstock acid oil needs to be certified as a co-product if those conditions are not met.

Soapstock acid oil shall not be certified as "Fatty acids".

At the point of origin, the auditor shall verify the plausibility of the soapstock and soapstock acid yields. Additionally, the records over time shall be reviewed.

Under ISCC EU, the risk level must always be high for all audits (certification and surveillance audits) of individually certified Points of Origin, Collecting Points, and Central Offices that handle waste/residues from processing of animal or vegetable oils, soapstock, food waste, POME oil, brown grease/grease trap fat, sewage sludge and/or UCO. General and specific requirements as listed in the document ISCC EU 203 – Traceability and Chain of Custody forms the basis of audit requirements for different supply chain elements handling wastes and residues.

3.4 Food Waste

3.4.1 Definition

Description of food waste

Food waste means all food, as defined in Article 2 of Regulation (EC) No 178/2002 of the European Parliament and of the Council, that has become waste. As with all wastes, this material must be unsuitable for other non-energy uses. Additionally, food waste can be considered as waste material if it is not suitable for further human and animal consumption.

Food waste includes:

- Out of date (food that has exceeded its shelf life)
- Out of specification (food that fails to meet the required end of use specification)

Food (or 'foodstuff') means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans. Food shall not include feed, which is defined as any substance or product, including additives, whether processed, partially processed or unprocessed, intended to be used for oral feeding to animals.[4] Food waste does not include beverages.

3.4.2 Target biofuels

Several biofuel target paths

Food Waste is a suitable feedstock to produce various biofuels, including biomethane, biodiesel and bioethanol. In general, the final fuel that can be produced depends on the physiochemical composition of food waste used.

Food waste can be valorised into biomethane due to its high organic material and moisture content. Food waste is placed in a digester to undergo anaerobic digestion, where microorganisms break down the waste in an oxygen-free environment to generate biogas. After purification, the biogas can be further refined into biomethane.

Bioethanol can also be produced from food waste rich in carbohydrates and soluble sugars, such as glucose and fructose, that can be converted to ethanol. Carbohydrate-rich food waste undergoes pre-treatment and hydrolysis, followed by fermentation and distillation to produce bioethanol. Various pre-treatment methods ensure that the soluble sugars convertible to ethanol are efficiently extracted. Additionally, oils and fats from food waste can be converted into biodiesel through transesterification. These oils and fats can also be used to produce Hydrotreated Vegetable Oil (HVO) through hydrotreatment.

[4] Art. 3 No. 4a of Directive 2008/98/EC (Waste Framework Directive – WFD)

3.4.3 Chemical and physical properties

Variation in food waste composition

Food waste contains large amounts of biodegradable components. It is rich in organic carbon and other elements that can be further utilised, such as nitrogen, phosphorus and potassium. In general, food waste is mainly composed of degradable carbohydrates (41–62%), proteins (15–25%) and lipids (13–30%).[5] Typically, food waste also has a high moisture content, ranging from 74–90%[6].

Nevertheless, it is important to note that the composition of food influences the physicochemical characteristics of the waste itself, depending on the place where it is produced. For example, food waste consisting mainly of rice, pasta and vegetables contains higher quantities of carbohydrates, while meat, fish and eggs have high concentrations of protein and lipids.

3.4.4 Description of points of origin

Generation of food waste

The point of origin is the stage at which food waste is generated in the supply chain. Here, more than 90% of ISCC certificates for food waste come from companies & businesses such as restaurants, food processors, manufacturers and retailers.

Under ISCC, the main points of origin for food waste include:

- Restaurants and food chains: Includes leftover and spoiled food, food preparation waste
- Food manufacturers and food processing facilities: Includes out-of-specification products and waste from food processing (e.g. vegetable and fruit peels, etc.)
- Retailers: Includes out-of-date food that must be discarded and unsold, spoiled food
- Households: Includes spoiled food, plate leftovers collected, and food preparation wastes (e.g. vegetable and fruit peels, fish bones, etc.)

Household and industrial food waste

In Spain, points of origin for food waste are further categorised. For example, the Spanish Order TED/728/2024[7] classifies food waste into two categories based on its point of origin. Household food waste includes biodegradable food and kitchen waste from homes, offices, restaurants, wholesalers, canteens, collective catering services, and retail establishments. It must be collected separately and is unsuitable for use in the human or animal food chain, excluding used cooking oils and animal fats, as specified in Part A,

[5] C. Braguglia, A. Gallipoli, A. Gianico, P. Pagliaccia, Anaerobic bioconversion of food waste into energy: a critical review, Bioresour. Technol. 248 (Part A) (2018) 37–56, doi: 10.1016/j.biortech.2017.06.145.
[6] H. Fisgativa, A. Tremier, P. Dabert, Characterizing the variability of food waste qual- ity: a need for efficient valorisation through anaerobic digestion, Waste Manag 50 (2016) 264–274, doi: 10.1016/j.wasman.2016.01.041.
[7] Orden TED/728/2024, de 15 de julio, por la que se desarrolla el mecanismo de fomento de biocarburantes y otros combustibles renovables con fines de transporte. https://www.boe.es/eli/es/o/2024/07/15/ted728

letter (c) of Annex I of RD 376/2022[8]. Industrial food waste refers to biodegradable food and kitchen waste from industries that is also unsuitable for human or animal consumption, excluding used cooking oils and animal fats. This category, defined in Part A, letter (d) of Annex I of RD 376/2022, includes pressing liquor derived from waste generated during citrus juice production.

3.4.5 Description of collection practices

Food waste certificates

Food waste collection practices vary widely, depending on government infrastructures and initiatives available, waste management systems and geographic location. In the context of ISCC, the majority of food waste enters the supply chain in Asian and European countries. In 2024, at the initial stage of the supply chain, 16% of ISCC food waste certificates are linked to operators in China, 16% to companies in the Netherlands, followed by 8% from Denmark and 7% from Spain. Therefore, the collection practices described below focus on the Chinese and European markets, as they are currently the most relevant for ISCC certification of food waste at the beginning of the supply chain.

Chinese collection practices

In China, food waste collection is shaped by a rapidly growing waste management infrastructure aimed at addressing large-scale urban and rural waste challenges. Households typically separate food waste as part of municipal solid waste programs. In recent years, cities such as Shanghai have implemented mandatory waste sorting regulations, requiring households to separate food waste from general waste. This sorted waste is collected by municipal services and transported to composting or anaerobic digestion facilities.

For commercial and industrial collection, food waste (e.g. leftover food) from restaurants, hotels, and food processing industries is collected by licensed waste management companies and taken to local centralised food waste treatment plants. This waste, commonly referred to as "swill" or "kitchen waste," is often recycled for use in biogas production or converted into animal feed under strict regulatory controls to avoid risks of contamination. In Hong Kong, food waste recycling points and recycling spots are set up at waste collection points, where smaller-scale restaurants can arrange to send their food waste to these designated locations for recycling.

European collection practices

In most European countries, food waste collection is generally well-structured, and many have already implemented separate collection systems for organic waste including food waste. Further, food producers, supermarkets, and restaurants work with licensed waste collection companies to ensure proper disposal and recycling. For example, the Netherlands has a highly structured and efficient system for collecting and managing food waste. For household collection, municipalities provide separate bins for organic waste (green bins),

[8] Real Decreto 376/2022, de 17 de mayo, por el que se regulan los criterios de sostenibilidad y de reducción de las emisiones de gases de efecto invernadero de los biocarburantes, biolíquidos y combustibles de biomasa, así como el sistema de garantías de origen de los gases renovables. https://www.boe.es/eli/es/rd/2022/05/17/376

which includes food waste. These bins are collected on a regular schedule and sent to centralised composting or anaerobic digestion facilities. Similar to this, supermarkets, restaurants, and food manufacturers often work with specialised waste collection companies to manage food waste that specialise in recycling food waste for energy (e.g. biogas) or composting. On a legal level, businesses are subject to strict regulations that require separate collection of food waste.

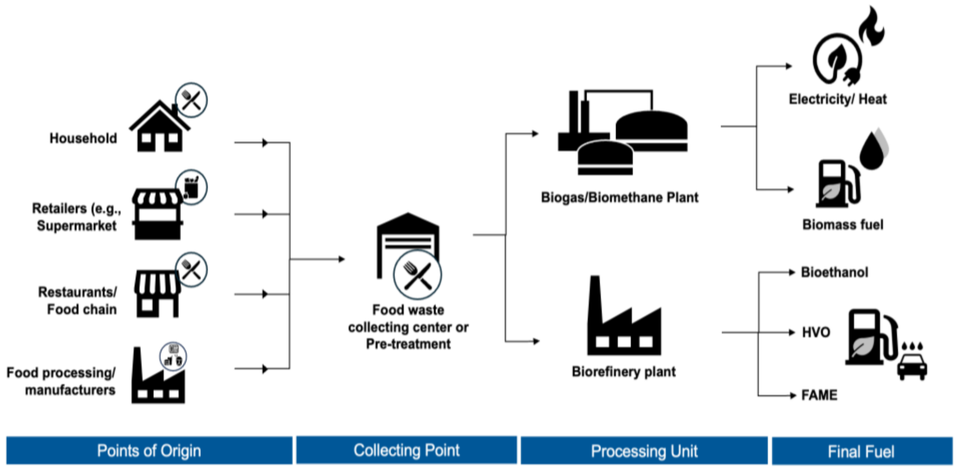
3.4.6 Guidance on assessing plausible yields

Variation in food waste yields

The amount of food waste generated at collection points can vary significantly based on factors such as regional dietary preferences, population density, and temporal fluctuations. For example, high-density urban areas typically produce more food waste due to a larger concentration of people, resulting in greater amounts of both residential and commercial food waste. In 2021, China generated approximately 35 million tonnes of food waste and around 50% of that food waste occurs at the last step in the supply chain, which is at retail or consumption.[9] In 2022, the EU generated around 132 kg of food waste per inhabitant, totalling approximately 59 million tonnes.[10] The biggest contributors of food waste in the EU are households (54% or 72kg per person), followed by food and beverage producers (21%), primary production (9%), restaurants and food services (9%), and retails and other food distributors (7%). Food waste volume can also fluctuate by season, holidays, or events. For instance, during holiday seasons, special events, or festivals, there is often a significant increase in food production and consumption, which leads to greater amount of food waste generated. Conversely, certain times of the year may see reduced waste output in food processing and retail, especially during off-seasons for local produce. For restaurants and food processing facilities, the ratio between input raw ingredients and resulting food waste must be checked using historical data such as production reports, invoices, waste disposal or collection rate, etc. For Collecting Points conducting mechanical treatment, the ingoing and outgoing amounts must be plausible and documented. Additional information showing collection routes, frequency of collection and historic data of collected amounts will also be crucial to check.

[9] https://earth.org/food-waste-in-china/
[10] https://www.statista.com/chart/31072/food-wasted-per-capita-in-european-countries/

3.4.7 Example supply chain



3.4.8 Audit considerations

Risk level for the audit

Under ISCC EU, the risk level must always be high for all audits (including certification and surveillance audits) of individually certified Points of Origin, Collecting Points, and Central Offices that handle food waste. Food waste can only be considered as waste material if it has no further use (other than for energetic applications) in other markets. Additionally, food waste can be considered as waste material if it is not suitable for further human and animal consumption. For instance, if food waste can be used as animal feed, it cannot be declared as waste because it has a further use. In this case, food waste would be considered a co-product.

Mislabelling of food waste

Mislabelling of food waste can also be a source of risk. The following materials must not be considered as food waste to avoid mislabelling.

Mislabelled material	Correct material name
Used oil from cooking	Used cooking oil (UCO)
Oil extracted from industry food waste	Industry food waste oil: Oil extracted from waste food from industry
Beverages	Drink waste

Additionally, damaged crops are **not** considered as food waste.

Expired cooking oil could be considered as food waste if there was no intentional modification or deliberate production involved. For this, extensive checking and further verification must be done. For example:

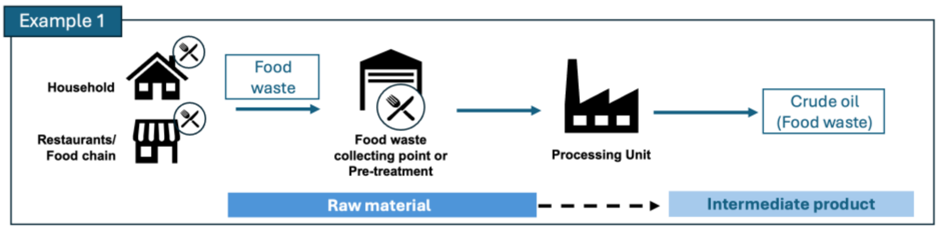
- Is there documentation of how the material is handled, such as purchase and storage records?
- Is there evidence that shelf life was modified to qualify as out-of-date?

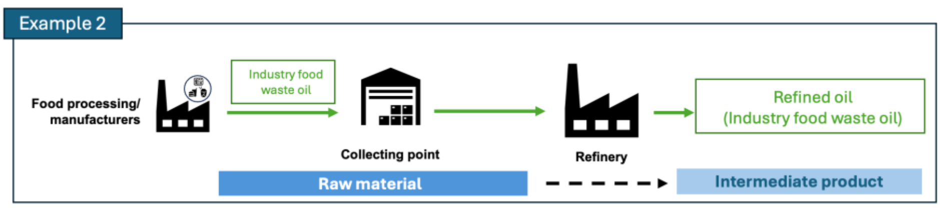
- Are the stated expiration dates aligned with standard industry practices?
- Are there national legislations or laws in place requiring the disposal of expired cooking oil?

Food waste oil vs. Food waste

Food waste oil extracted from waste food from industry must be declared as "Industry food waste oil" and must be certified as separate raw material from food waste. Under the Renewable Energy Directive, oil extracted from food waste from industry falls under the following sub-category in the Implementing Regulation (EU) 2022/996 as Annex IX Part A d): Food waste oil - Oil extracted from waste food from industry. It is important to note that UCO and animal fats are not included here and therefore cannot be classified as industry food waste oil.

To differentiate between the raw material "Industry food waste oil" from the intermediate product "Crude oil (Food waste)", the following examples are shown below. In Example 1, various food waste from households and restaurants are collected before processing to extract crude oil from food waste. Here, "Crude oil (food waste)" is considered as intermediate product, but not as raw material. In contrast, Example 2 shows how "Industry food waste oil" is considered as a raw material that can be further processed (e.g., in a refinery to produce refined oil):





Additionally, industry food waste oil must be obtained from industrial applications. For example, waste oil from industrial food processing, including oil recovered after flushing production assembly lines with food-grade vegetable oil in food processing facilities, can be classified as industrial food waste oil.

3.5 Sewage sludge

3.5.1 Definition

Composition

Sewage sludge is the semi-solid byproduct generated during the treatment of municipal waste water. It consists of organic and inorganic materials, including water, nutrients, microorganisms, heavy metals, and other contaminants. Sewage sludge is typically processed through thickening, digestion, dewatering, and stabilisation to reduce pathogens and environmental impact before disposal, land application, or conversion into biofuels.

"Sewage sludge" is listed in Annex IX Part A. (f) of the Renewable Energy Directive.

3.5.2 Target biofuels

Biogas and liquid fuels are target fuels

Sewage sludge can be converted into various types of biofuels through different processing technologies. However, the most established route is to biomethane. This pathway involves anaerobic digestion, which breaks down organic matter to produce biogas, primarily composed of methane and carbon dioxide. This biogas can be upgraded to biomethane.

Another method is hydrothermal liquefaction, which converts sludge into a bio-crude oil that can be further refined into biodiesel, sustainable aviation fuel (SAF), or other liquid biofuels. Additionally, pyrolysis and gasification processes can generate biochar, syngas, and hydrogen, which have applications in energy production and as feedstocks for synthetic fuels. The suitability of each pathway depends on factors such as sludge composition, treatment infrastructure, and regulatory requirements.

3.5.3 Chemical and physical properties

High water content and properties vary

Sewage sludge is a heterogeneous material with highly variable physical properties depending on its source, treatment process, and moisture content. Typically, it has a high water content, ranging from 80% to 98% in untreated sludge, which necessitates dewatering before biofuel conversion. The solid fraction consists of organic matter, inorganic minerals, and microbial biomass. The particle size varies from fine colloidal particles to larger aggregates, influencing handling and processing efficiency. Density varies based on treatment stage, with raw sludge being less dense and dewatered sludge having a higher bulk density. The viscosity of sludge can be significant, affecting pumping and transport in biofuel production processes. Additionally, the volatile solids content (typically 50% to 70% of total solids) is a key factor in determining the biofuel yield, as it represents the fraction available for biochemical or thermochemical conversion.

3.5.4 Description of point of origin

Municipal wastewater treatment plant as PoO

The point of origin for sewage sludge is a municipal wastewater treatment plant (WWTP) or a facility treating residential, commercial, or industrial wastewater. These facilities receive and process wastewater through a series of physical, chemical, and biological treatments to remove contaminants before discharging treated effluent into the environment. During this process, solids settle out and are collected as sewage sludge.

Sewage sludge may also originate from decentralised wastewater treatment systems, such as septic tanks or small-scale treatment plants serving rural communities, provided that proper collection, transport, and treatment procedures are documented.

Material taken directly from a sewer system, such as from combined sewer overflows or grit chambers, may only be classified as sewage sludge if detailed and auditable records are maintained. These records must include the exact location of collection, date, quantity, and a description of the material to verify its composition and suitability for biofuel conversion. The traceability of sludge origin is crucial for compliance with sustainability and environmental regulations, ensuring that only eligible feedstocks are used in biofuel production.

Material produced at industrial wastewater treatment facilities should not be certified as sewage sludge. This material should be certified under “Industrial wastewater and derivates” of Annex IX Part A (d) as per Implementing Regulation (EU) 2022/996.

3.5.5 Description of collection practices

Sewage sludge processing can occur at WWTP

Sewage sludge may either be processed to a biofuel at the WWTPs or transported to another location. The degree of integration is connected to the size of the WWTPs. Larger WWTPs may be equipped with anaerobic digesters to process sludge into biogas. In some cases, sludge is dewatered and transported to off-site processing plants where it can be further treated for biofuel production. Transport is common when the WWTP lacks the infrastructure for energy recovery or if centralised processing is more economically viable. Some WWTPs may perform partial treatment (e.g., anaerobic digestion to produce biogas) and then send the remaining sludge to another facility for further processing. For example, digested sludge may be dried and transported to a gasification or hydrothermal liquefaction plant to produce other biofuels.

3.5.6 Guidance on assessing plausible yields

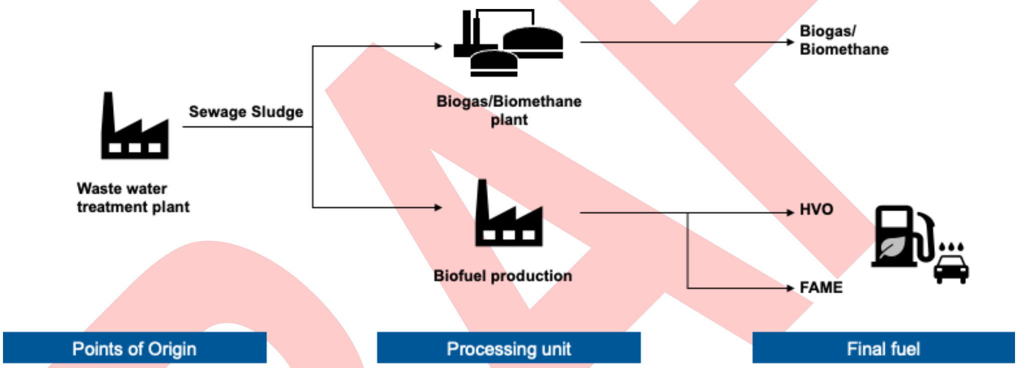
Yields depend on service area

The amount of sludge generated at a wastewater treatment plant is primarily influenced by the volume and composition of incoming wastewater, which varies based on the facility's service area, population size, and industrial activity. The type of treatment processes used, such as primary sedimentation, biological treatment, and chemical precipitation, also affect sludge yield.

A critical factor in sludge mass is water content, which can vary significantly depending on dewatering methods and treatment stage. Raw sludge is typically 80–98% water, whereas mechanically dewatered sludge can have a solids content of 15–30%, dramatically reducing overall mass and volume for disposal or biofuel conversion.

Sludge production rates differ globally due to population density, wastewater treatment infrastructure, and regulatory standards for sludge management. In 2020, Europe produced approximately 13 million tonnes of dry sludge, averaging around 29 kg per capita. Meanwhile, China generated 40 million tonnes at an average of 28 kg per person.

3.5.7 Example supply chain



3.5.8 Audit considerations

High risk level must be applied

Under ISCC EU, the risk level must always be high for all audits (certification and surveillance audits) of individually certified Points of Origin, Collecting Points, and Central Offices that handle waste/residues from processing of animal or vegetable oils, soapstock, food waste, POME oil, brown grease/grease trap fat, sewage sludge and/or UCO. General and specific requirements as listed in the document ISCC EU 203 – Traceability and Chain of Custody forms the basis of audit requirements for different supply chain elements handling wastes and residues.

The auditor shall particularly check the records over time and watch out for (sudden) increases. Additionally, the auditor shall verify the plausibility of the yields.

3.6 Spent Bleaching Earth

3.6.1 Definition

Composition of SBE

Spent Bleaching Earth (SBE) emerges from the refining of vegetable or animal oils. It consists of bleaching earth (clay) that is added to the oil in order to purify it by adsorbing importities. SBE there is saturated with oil and contaminants. The absorbed oil can be recovered as the so called Spent Bleaching Earth oil (SBEO). SBE shall be certified as “Spent Bleaching Earth” with a specification of the raw material or crop in brackets.

3.6.2 Target biofuels

Different biofuels are targeted

SBEO can be used to produce biofuels like Biodiesel or HVO. However, SBE can also directly be sent to anaerobic digesters for the production of biogas and burnt to produce heat for example in a cement plant.

3.6.3 Chemical and Physical properties

Properties depend on type of bleaching earth

SBE is a fine, soft porous powder of gray/brown/yellow color with mild to strong odor. The properties depending on the type of oil refined and the type of earth being used. It is slightly acidic pH (4–6), depending on the type of bleaching earth and processing conditions.

SBE can self-heat and undergo spontaneous combustion due to the oxidation of residual oil. This is why treatment plants (recovering adsorbed oil) are typically located close to refineries if they don’t do the treatment by themselves.

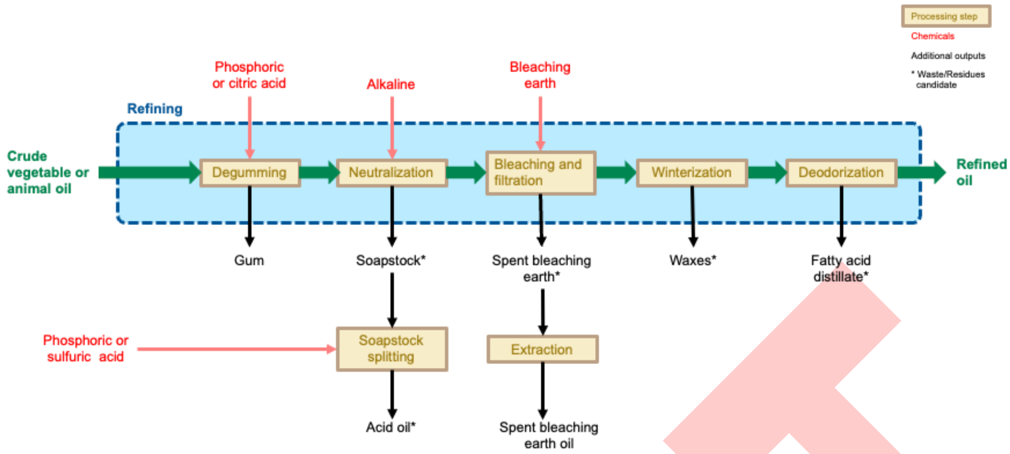
3.6.4 Oil refinery as point of origin

Bleaching is a typical step at refineries

In an oil refinery, the bleaching earth is added to the oil to adsorb impurities during the so called bleaching step. This step also removes pigments and other colour bodies leading to a lighter colour. Due to this visual effect, the process is called bleaching. Note that this process step may be skipped for cold-pressed oils or oils refined for non-food uses (e.g., biodiesel or industrial oils). During bleaching, the bleaching earth is added to the oil to adsorb impurities. Afterwards the SBE is filtered out leaving a purified (bleached) oil.

There can be (integrated) oil mills recycling SBE into the milling process of crops, pressing the oil out of SBE and thus improving overall oil yields while clay ends in meal. Whether this is done depends on the type of clay and local regulations on using meal for feed purposes. Please note that the refined oil produced in such a set up shall be attributed to the crops only, i.e., the yield optimisation of the refined oil is not considered waste-derived / SBEO.

Following a schematic of a refinery, doing chemical refinement, is shown. Note that this is an illustrative example and that bleaching can also be done in physical refineries.



3.6.5 HVO plant as point of origin

Bleaching may be done at HVO plants

Bleaching is an important pre-treatment step at HVO plants when waste oils like UCO, POME or tallow are processed. At an HVO plant, the bleaching step particularly aims to remove impurities such as metals to avoid poisoning of catalysts that is needed for the hydrotreatment.

3.6.6 Collection practices and recovery of spent bleaching earth

Residual oil can be recovered from SBE

The residual oil present in SBE can be recovered and be used for fuel production. There are different process available:

- Solvent Extraction: This process is commonly used and requires solvents like hexane or ethanol. Solvent extraction is efficient but may require additional steps to remove residual solvent.
- Mechanical Pressing: This process is less efficient than solvent extraction but environmentally friendlier as no solvents are used.

The recovered oil can be processed into biofuels as well as low-grade industrial oil.

The recovery of SBE oil might take place at the oil refinery or a dedicated SBEO recovery plant

3.6.7 Guidance on assessing plausible yields.

Yields depend on oil type

At an oil refinery spent bleaching earth yields ranges typically from 1% to 5% of the crude oil depending on type of oil and its purity. Vegetable oil has usually lower yields compared to animal oils.

Spent Bleaching Earth contains typically 10 to 50% oil which can be extracted with an efficiency of 60 to 80%, depending on the extraction process. In same cases the efficiency may even exceed 90%.

The auditor should check whether the amount of SBE per ton of oil did change over time. Additionally, the yields in the oil recovery and its development over time shall be checked.

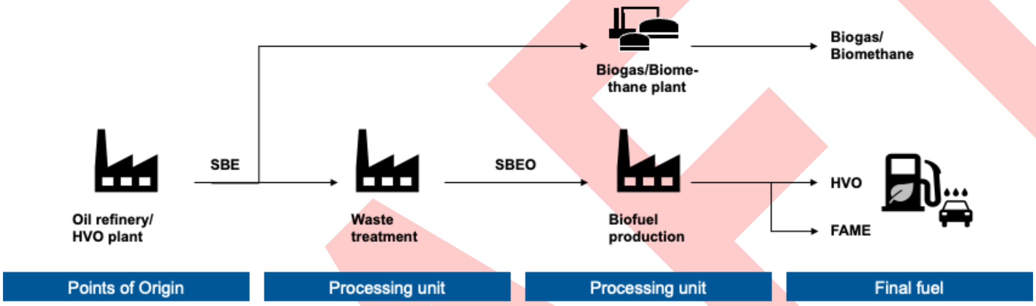
To illustrate the expected SBE oil yield, see the example below:

10 ton SBE with an oil content of 50% and a recovery of 80% lead to 4 ton of SBEO.

$$m_{SBEO} = m_{SBE} * x_{oil\ content} * r_{recovery\ rate}$$

$$= 10\ ton * 50\% * 80\% = 4\ ton$$

3.6.8 Example supply chain



3.6.9 Audit considerations

Refineries require individual certification as PoO

Under ISCC EU, the risk level must always be high for all audits (certification and surveillance audits) of individually certified Points of Origin, Collecting Points, and Central Offices that handle waste/residues from processing of animal or vegetable oils, soapstock, food waste, POME oil, brown grease/grease trap fat, sewage sludge and/or UCO. General and specific requirements as listed in the document ISCC EU 203 – Traceability and Chain of Custody forms the basis of audit requirements for different supply chain elements handling wastes and residues.

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