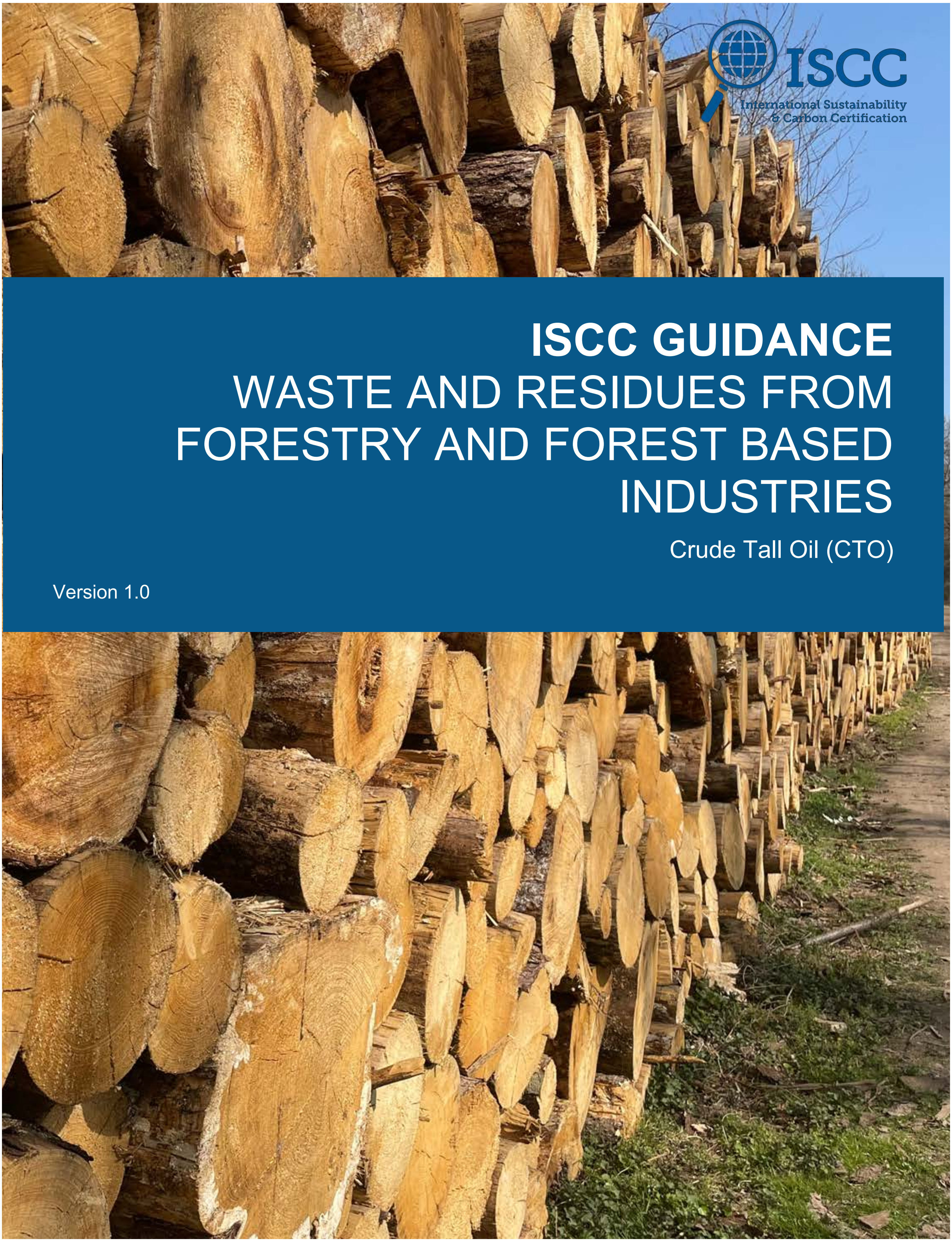

ISCC
International Sustainability & Carbon Certification

ISCC GUIDANCE
WASTE AND RESIDUES FROM FORESTRY AND FOREST BASED INDUSTRIES

Crude Tall Oil (CTO)

Version 1.0

Document Title: ISCC Guidance on Waste and Residues from Forestry and Forest Based Industries

Version 1.0

Valid from: DRAFT

Content

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 from forestry and forest based industries. Topics like the properties of the waste and residue feedstocks, supply chain elements involved and points to consider for plausibility are described. 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

Annex IX, (o) materials are addressed

This section contains detailed information on a selection of waste and residue feedstocks listed in Annex IX (o) of the Directive (EU) 2018/2001. Materials covered in this document will be expanded through ongoing consultation with ISCC stakeholders. Feedstocks have been selected on a risk basis and through discussions with ISCC system users and stakeholders.

Feedstocks covered by this document include: Crude Tall Oil (CTO).

3.1 Crude Tall Oil (CTO)

3.1.1 Definition

CTO occurs in the Kraft pulping process

Typically, CTO is generated in pulp mills as part of the chemical "Kraft" pulping process[1]. The feedstock for the pulping process is wood (mainly softwood, hardwood). The main product of the process is pulp which can be further processed into e.g. paper and other products.

CTO is mainly generated in the pulping of softwood (e.g. pine, spruce, fir and redwood). Only relatively small amounts of CTO can be extracted from

[1] The Kraft pulping process (also kraft pulping, sulphate process) is a technology to process wood into pulp. Wood chips are processed with hot water, sodium hydroxide (NaOH) and sodium sulphide (Na_2S) („white liquor") to chemically break the strong structure of wood into its components lignin, hemicellulose and cellulose. The whole process can be divided into different steps. The process must be clearly differentiated from the *acidic sulphite process* also degrading the chemical bonds of wood components.

hardwood (e.g. birch). Birch is the only hardwood that has CTO extractives. No CTO is generated in eucalyptus pulping process.

As part of the pulping process, black liquor is generated. Black liquor contains different valuable materials/ chemicals that can re-used in the pulping process. Alternatively, black liquor can also be used energetically.

To further re-use these chemicals, black liquor is further processed. As part of this processing and as a result of evaporation of the black liquor, a soap layer is removed from the remaining material. This layer is called Crude Sulphate Soap (CSS). The CSS can be either burned as a process fuel or further processed into CTO.

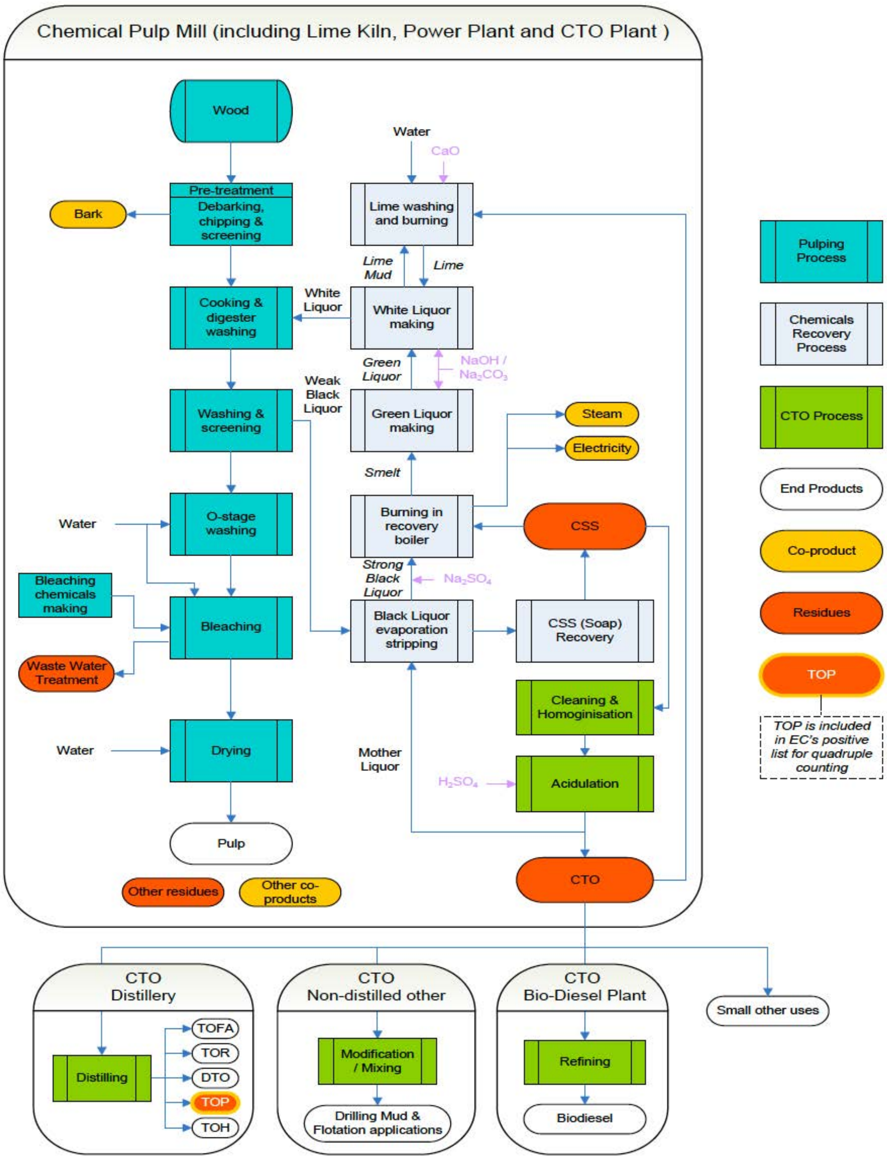

***Figure 1**: Overview chemical pulping (kraft pulping). Taken from: Peters and Stojcheva (2017)*

CTO is processed in an acidulation facility (dedicated production line)

The extraction of CTO takes place in a dedicated production line being integrated into the pulp mill (acidulation facility). Only in few cases, these CTO facilities are stand-alone plants (acidulation plants) where Crude Sulphate Soap (CSS) is acidulated into CTO.

CTO can be used:

- As a process fuel in the pulp mill
- Distilled into different products (via CTO distillers)
- In the petroleum industry (e.g. as an extraction drilling fluid)
- Feedstock for biofuels production

3.1.1.1 Global Supply of CTO

The total global CTO production is estimated at around 2 million tonnes per year. Pulp mills have a potential to produce about 2.8 million tonnes CTO per year. The largest producers are the United States, the Scandinavian countries (notably Sweden and Finland) and Russia. These three regions combine for a global market share of more than 90%.

The following list includes major CTO producing countries:

- United States: As one of the world's largest producers of softwood pulp, the U.S. is a leading CTO producer.
- Sweden: With a robust forestry sector, Sweden has a significant pulp industry, contributing to substantial CTO production.
- Finland: Similar to Sweden, Finland's extensive forests support a large pulp and paper industry, making it a key CTO producer.
- Canada: Canada's vast softwood forests and pulp mills contribute to its position as a major CTO producer.
- Brazil: While primarily known for hardwood pulp, Brazil also produces softwood pulp, leading to CTO production.
- Russia: With expansive forests and a growing pulp industry, Russia contributes to global CTO production.
- Germany: Germany's pulp and paper industry, though smaller than some others, still contributes to CTO output.

3.1.1.2 Global Pulp and Paper Mill Database (CGFI)

The UK Centre for Greening Finance and Investment (CGFI) offers a comprehensive *Global Pulp and Paper Mill Database*. This resource provides detailed information on pulp and paper production facilities worldwide, including their locations and operational details. The database is available under a CC BY 4.0 license and can be accessed on this website.

3.1.2 Target biofuels

CTO as feedstock for HVO, biodiesel

CTO is a suitable feedstock for biodiesel, hydrotreated vegetable oil (HVO), SAF/ HEFA 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

CTO quality parameters

CTO is a dark brown viscous liquid that is produced from the acidulation of CSS. CTO contains rosins, unsaponifiable sterols, rosin acids, fatty acids and tall oil pitch as its main fractions. The share of those fractions as well as the quality, chemical and physical properties of CTO depend on multiple factors, e.g. mainly on the type of wood processed (softwood, hardwood).

Crude tall oil is a dark brown viscous liquid with a complex composition of fatty acids, rosin acid, sulfonated carboxylic acids and plant sterols. Its composition varies. The main groups of constituents are[2]:

20-60 % w/w saturated and unsaturated C8 – C28 fatty acids

0-65 % w/w rosin acids

0-10 % w/w plant sterols

0-8 % w/w terpenes

The CAS[3] Number of CTO is 8002-26-4.

3.1.4 Description of point of origin

PoO for CTO must be a pulp mill

CTO is always generated at a pulp mill which

a) is using the Sulphate Kraft pulping process

b) includes an integrated acidulation facility in use

c) is processing either softwood or Birch

Only those site (pulp mill) can be the Point of Origin (PoO) for CTO. Pulp mills using other chemical and/ or mechanical processes to produce pulp cannot be classified as a PoO for CTO, as the material is not occurring at these sites. CTO should be classified as an advanced feedstock in line with Annex IX, Part A, (o).

CTO originates from black liquor, which is also classified as an advanced feedstock. In case of an acidulation plant wherein CSS is processed into CTO independent of a pulp mill, this site shall be certified as a processing unit but cannot be the PoO for CTO.

[2] ECHA database, https://echa.europa.eu/de/registration-dossier/-/registered-dossier/15525#:~:text=Display%20Name%3A-,Crude%20Tall%20Oil%20(CTO)%20is%20obtained%20from%20the%20wood%20pulping,%2C%20resin%20acids%2C%20and%20neutrals.

[3] CAS number is a unique numerical identifier assigned to chemical substances by the Chemical Abstracts Service to provide a reliable and standardised way of identifying chemical substances

3.1.5 Description of collection practices

Certification scope for CTO traders and acidulation plants

CTO is a valuable material that is traded internationally. Companies (traders) are collecting CTO from different processing units as well as other traders. It is crucial for the certification scope of the ISCC system users to differentiate between CTO being collected directly from a PoO (pulp mill), which must be covered under the scope of a CP, and volumes of CTO received from traders and acidulation plants, which must be certified under the scope of a Trader.

3.1.6 Guidance on assessing plausible yields

Yields for CTO from the pulping process

CTO yield depends on the kraft pulping process, and therefore on the output of the pulp production. On average, the yield of CTO is 30 – 50 kg per tonne of produced pulp[4]. The CTO extraction from hardwood can be enhanced by circulating CTO to hardwood cooking.

If a mix of softwood and hardwood is used in the pulping process (typical process), CTO yields are between 1.25 – 5% (12.5 - 50 kg per tonne of produced pulp) of the total amount of pulp produced. The more softwood is used as a feedstock for the pulping process, the higher the CTO yield is. For plant processing solely birch, yields might be up to 8% of the pulp production. In case 100% hardwood is processed, CTO yields are max 2.5% of the pulp produced.

3.1.7 Example supply chain

Typical CTO supply chain

The Point of Origin (PoO) for CTO is always the pulp mill or pulp mill with acidulation facility at which the material occurs. The next element of the supply chain receiving the CTO from the pulp mill is the Collecting Point (CP).

Acidulation plants are processing CSS into CTO. These plants must be certified under the scope of a processing unit. In some cases, an acidulation plant can receive CSS from various pulp mills for processing into CTO. In this scenario, the independent acidulation plant can be considered both as the Collecting Point and Processing Unit.

If later in supply chain CTO quality is upgraded or CTO is further purified, the PoO stays with the original PoO, and the country of origin does not change.

CTO distillers are processing CTO into different products and must be certified under the scope of a processing unit. The main distillation products of CTO include distilled tall oil, tall oil fatty acid, tall oil pitch, tall oil rosin and tall oil heads.

Further, HVO plants and biodiesel plants can process CTO into HVO and FAME, respectively, and thus must be certified under the scope of a HVO and/or biodiesel plant.

[4] See Aryan and Kraft (2021); Särkkä, Gutiérrez-Poch and Kuhlberg (Eds.), Technological Transformation in the Global Pulp and Paper Industry 1800-2018, 23, Springer International Publishing (2018)

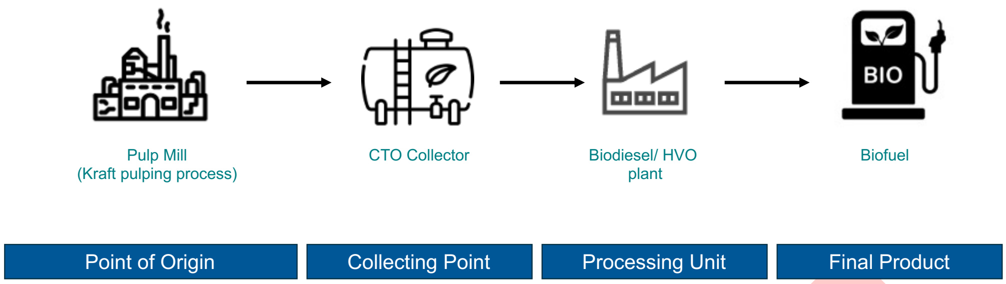

***Figure 2**: Typical CTO supply chain and certification scopes*

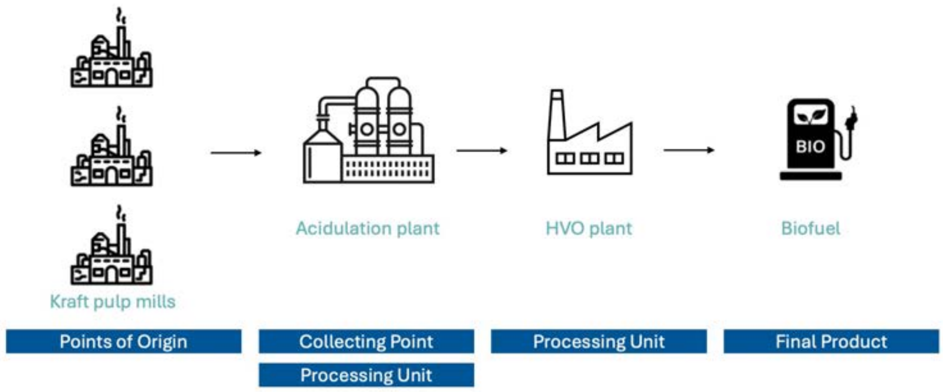

***Figure 3**: CTO supply chain example with independent acidulation plant*

3.1.8 Audit considerations

General audit requirements in ISCC EU 201 and ISCC EU 203

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 CTO supply chains. Risk-based audit approach must be applied according to ISCC EU 201- System Basics. For example, a higher risk classification has to be applied for materials that may be eligible for additional incentives, such as double counting. It is important to note here that higher risk classification implies an increase in the risk classification based on the risk assessment, but not necessarily default classification to high-risk audit.

CTO is included on Annex IX, Part A of the RED and thus qualifies as an advanced feedstock. Thus, there is a risk of re-labelling of non-advanced feedstocks to CTO. Consequently, auditors shall always check the origin of CTO and verify on random basis deliveries from CTO suppliers. The database (see 3.1.1.2) supports auditors to conduct plausibility checks on the origin of CTO from pulp mills using the kraft pulping process.

The information on sustainability characteristics documented on the Proof of Sustainability for all deliveries of sustainable material must be correct. This includes the information on the country of origin of the feedstock. Auditors shall verify information on country of origin of the CTO. The country of origin must be the country in which the pulp mill at which the CTO occurs is located and not the country of residence of a CTO supplier. Also, if CTO is purified or the quality is upgraded in another country, country of origin is the country where CTO originates, not where further processing steps occur. Countries, in which no pulp mills using the Kraft pulping process exist cannot be claimed as "country of origin".

3.1.8.1 Point of Origin

Check of existing infrastructure for CTO production and yield plausibility at the PoO

The PoO must be a pulp mill using the Kraft pulping process and must have an on-site acidulation facility. The auditor must verify, if this technology is operational at the pulp mill. The feedstock shall be classified as CTO. Volumes of CTO must be checked using the typical yield information for CTO (see chapter 3.1.6).

Not all pulp mills have on-site CTO production capacity and thus auditors shall verify, if the "infrastructure" for CTO production (integrated acidulation facility) is available. Independent acidulation plants (standalone site processing CSS into CTO) cannot be certified under the scope of a PoO, but must be classified as processing unit. In the case of these standalone acidulation plants, the feedstock is not CTO but CSS.

3.1.8.2 Collecting Point

CP must be audited on-site

CPs must be audited on-site. Auditors shall assess bookkeeping of wastes and shall assess the correct classification of the CTO according to its chemical and physical properties. CTO must be supplied directly from pulp mills (being the PoO). For each pulp mill supplying CTO, a self-declaration must be signed and available for the audit. Information on each supplier must be documented in the ISCC HUB including information on the address and the geo-coordinates of the pulp mill. As the number of sites being able to produce CTO is limited and relatively small, auditors shall use the information on CTO suppliers to conduct plausibility checks, if those suppliers are actually pulp mills with the integrated acidulation facility.

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).

3.1.8.3 Processing Unit, Biodiesel or HVO plant

Verification of mass balancing of HVO for auditing processing unit

At this stage of the supply chain, the auditor must check the correct documentation and mass balancing of the CTO that is being processed into different output materials. In addition to this, auditors may check any certificate of analysis available including product description of CTO. 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.

3.1.9 Literature

Relevant sources for information on CTO supply chains, processing

Besides the valuable input and feedback from ISCC stakeholders, the following documents have been used to develop this guidance document:

- Aryan, V., & Kraft, A. (2021). *The crude tall oil value chain: Global availability and the influence of regional energy policies.* Journal of Cleaner Production, 280, 124616. Available at: https://doi.org/10.1016/j.jclepro.2020.124616, downloaded 7th May 2025
- Daan Peters, Viktorija Stojcheva (2017): *Crude tall oil low ILUC risk assessment*, ECOFYS by order of UPM. Available at: https://www.upmbiofuels.com/siteassets/documents/other-publications/ecofys-crude-tall-oil-low-iluc-risk-assessment-report.pdf, downloaded 7th May 2025
- Sébastien Haye (E4Tech) et al. (2022): *Assessment of new advanced biofuel feedstocks*, ENER C1 2019-412, Final Report. Available at: https://op.europa.eu/de/publication-detail/-/publication/ec9c1003-76a7-11ed-9887-01aa75ed71a1/language-en, downloaded 7th May 2025