

# Analysis Of Eucalyptus Oil Distillates Traditionally

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**Abstract:** Eucalyptus oil refinery in Namlea using water distillation (direct distillation method) where distillers process is the same as the desalination process for clove leaf. In this study, the raw material used eucalyptus leaves as much as 250 kg, without any treatment of the raw material. Calor average to heat the boilers on the first day and the second day 1371.69 Kcal and 1499.54 Kcal. Results of laboratory analysis showed the quality of eucalyptus oil for refining and processing plant traditionally are quite popular among the public is used to show a significant difference. Distilling eucalyptus leaves (*Melaleuca Cajuputi*) produces eucalyptus essential oil, eucalyptus oil quality standards in Indonesia used SNI 06-3954-2006. For sample I (traditional) sineol content of 67.569%, the refractive index of 1.464, optical rotation 1.850, and a the specific gravity 0.849. For samples II (factory-made) Sineol Content 60, 186%, a refractive index of 1.467, -2.550 optical rotation, and a specific gravity of 0.845.

**Keywords:** eucalyptus oil, heat, SNI, Sineol content.

## 1. Introduction

Eucalyptus plantation area in Indonesia is estimated to 248-756 ha. Eucalyptus plants can grow well, including the less fertile land for food crops. Eucalyptus oil is produced from the essential oil of eucalyptus plants (*Melaleuca cajuputi*), which grow naturally in the Moluccas islands and northern Australia. This species has been wide spread in Indonesia, especially in Java and Moluccas with leaves and branches to utilize traditional distilled by society and commercially be the essential oil of high economic value. This plant has along biological cycle, fast growing, can grow well in soil that is well drained and not with high salinity and acid to lerant and open place (Guntur, 2006). Eucalyptus leaves contain chemical compounds, among others: sineol, melaleucin, essential oils consisting of terpineol, cineol and lignin (Agustina, 2010).

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Eucalyptus oil is included in the kind of essential oil. Indonesia's tropical climate make Indonesia as the producer of this oil with one of the producers is very well known is the Moluccan islands in the village of Lala, the island of Buru. In this method of distilling kettle filled with water up to nearly half of the volume of the kettle and then heated. Prior to boiling water, raw materials (eucalyptus leaves) entered into the refining kettle. Thus the evaporation of water and eucalyptus leaves will take place together. Distillation method is called direct distillation (direct distillation) (van Harling 2007). Kettle used for distillery in the village of Lala still traditional, made of wood materials for wall covering skettle, ironpipes, chimneys of brass. According to the community eucalyptus oil produced very good quality. For steam pipeline oil mixed with water will be converted into a long pipe and do not use conditioner.

## **2. Research Methods**

Refining or distillation is a process where a mixture of two or more liquid is heated to a boiling point or to a boil, and drain into the steam condenser and collecting the condensation. The first steam coming from the boiling liquid contains the most volatile part of the liquid flowing out faster. This vaporentering through the pipes into the cooler, condenses and comes out as a liquid distillate called distillate.

Distilling the remaining liquid, its structure becomes transformed into a liquid in which the more the liquid is more difficult to evaporate or less volatile liquid. If the distillation continued, the arrangement of liquid boiling and arrangement of steam that together occur fickle slowly, while the liquid boiling temperaturerises.

### **2.1 The Equipment and Materials**

The materials used in this research was 250kg of eucalyptus leaves. The equipment used is a digital thermometer, Aneroid Barometer, Hygrometer, stove, kettle refining, iron pot. Quality testing instruments eucalyptus oils, among others pycnometer, refractometer, Polarimeter (POLAX 21, Atago), Gas Chromatography.

Parameters that can be used for the physical constants of essential oils, among others:

#### **a. the specific gravity**

The specific gravity is the weight ratio of a volume of the sample at a temperature of 250C with the weight and volume of water at the same temperature. This method can be used for all oils and fats are melted. The tools used for this determination is pycnometer. In the determination of the specific gravity, temperature controlled carefully in a short temperature range (Ketaren, 1985).

b. Refractive Index

The refractive index of a material is the ratio of the speed of light in air and the speed of light in the substance. If light passes through the media less to more dense medium, then the light will be turned or refracted from the normal line. Determination of the refractive index using a refractometer. The refractive index of a substance useful for the identification and detection of impurities (Guenther, 1987).

c. Optical Rotation

Every kinds of essential oils have the ability to rotate the plane of polarization of light to the left or right. The size of the playing field of polarization is determined by the type of essential oil, the temperature and the wavelength of light used. Determination of optical rotation using a polarimeter. Heat energy or useful is the energy used to heat and evaporate the water. So energy is useful when viewed from the increase in temperature and the amount of evaporated water mass, is:

$$Q_K = \ell_m \cdot c_p \cdot (T_i - T_0) + m \cdot h_{fg} \tag{1}$$

Where::

$Q_K$  = heat are useful, (kkal)

$\ell_m$  = mass rate of condensate production (kg/s)

$c_p$  = Specific heat of eucalyptus oil (J/kg. K)

$T_2$  = final temperature of eucalyptus, ( $^{\circ}C$ )

$T_1$  = initial temperature of eucalyptus oil ( $^{\circ}C$ )

$h_{fg}$  = heat of vaporization of eucalyptus oil, 204 kkal/kg, (Giancoli, 1999)

**Tabel 1.** Physical and chemical properties of eucalyptus oil.

Properties	Gasoline	Diesel	Eucalyptus Oil
Formula	C <sub>4</sub> to C <sub>12</sub>	C <sub>8</sub> to C <sub>25</sub>	C <sub>10</sub> H <sub>18</sub> O
Molecular weight	105	200	154
Composition % Wt	C <sub>88</sub> H <sub>15</sub>	C <sub>87</sub> H <sub>16</sub>	-
The specific gravity kg/m <sup>3</sup>	780	830	913
Specific gravity	0.78	0.83	0.918
Boiling point $^{\circ}C$	30-220	180-340	175
Viscosity c St	0.4	3-4	2.0
Latent heat of vaporization kJ/kg	350	230	305

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Lower heating value kJ/kg	43,890	42,700	43,270
Flash point ° C	- 43	74	53
Auto ignition temperature ° C	300-450	250	300-330
Flammability limit % volume	1.4	1.0	0.8
Cetane number		40-55	

Source: Tamilvendhan, 2011

In the distillation process there is heat energy is lost due to the difference in average temperature in the kettle with the environmental temperature. The condenser is a major fixture in the distillery. The condenser serves to change the entire steam eucalyptus leaves into the liquid phase. The amount of heat released in the event of condensation is proportional to the heat required for vaporizing steam eucalyptus leaves. The amount of heat that can be released by the vapor condensates (Holman, 1986).

**Table 2. Quality requirements eucalyptus oil**

No	type of test	unit	requirements
<u>1</u>	<u>state</u>		
	<u>Color</u>	-	<u>clear to yellow-green</u>
	<u>Odor</u>	-	<u>typical eucalyptus</u>
<u>2</u>	<u>The specific gravity 20°C/20°C</u>	-	<u>0.900-0.930</u>
<u>3</u>	<u>The refractive index (n<sub>D</sub><sup>20</sup>)</u>	-	<u>1,450-1,470</u>
<u>4</u>	<u>Solubility in ethanol</u>	-	<u>1:1 to 1:10 clear</u>
<u>5</u>	<u>Optical Rotation</u>	-	<u>(-4) to 0<sup>0</sup></u>
<u>6</u>	<u>The content sineol</u>	<u>%</u>	<u>50-65</u>

Source: National Standardization Agency (BSN) 2006.

## 3. Results and Discussion

### 3.1 Analysis of Heat Transfer On eucalyptus Oil

Based on the results of calculations during the 8-hour average value on the first day, the average is 1371.697 kcals, on the second day was 1499.54 Kcal. for 9 hours on the day I was 880,816.5, on the second day was 880,347.9. The results of data collection during the refining process of oil of eucalyptus (eucalyptus

leaves) by using a condenser made of brass binoculars for 2 days with average refining time of 8 hours and retrieval of data is done every 15 minutes.

**Table 3.** Analysis of heat required to heat boiler average value per 1 hour, day 1 and day-2

Observation time (hours)	Average $Q_k$ Kkal	
	Day-1	Day-2
08:00 - 09:00	857,63	857,63
09:00 - 10:00	1055,60	1055,60
10:00 - 11:00	1065,84	1298,80
11:00 -12:00	935,29	1792,88
12:00 - 13:00	970,27	1679,10
13:00 - 14:00	1517,25	1893,57
14:00 - 15:00	2250,26	1774,96
15:00 – 16:00	2165,78	1793,73
16:00	2106,90	1721,20

**Table 4.** Analysis of convection heat transfer coefficient on the outside surface average value per 1 hour, the day-1 and day-2.

Observation time (hours)	Average $h_o$ , (W/m <sup>2</sup> .K)	
	Day-1	Day-2
08:00 - 09:00	886538,92	886734,86
09:00 - 10:00	885891,10	885988,14
10:00 - 11:00	881369,03	881838,59
11:00 -12:00	879919,52	878252,08
12:00 - 13:00	879796,56	877972,32
13:00 - 14:00	878125,90	877479,80
14:00 - 15:00	877563,43	876933,54
15:00 – 16:00	876717,46	876362,78
16:00	876515,87	876469,52

### 3.2 Analysis of eucalyptus Oil

Quality Test Analysis of quality test aims to determine the content sineol, ethanol content, refractive index, optical rotation, the specific gravity (specific gravity). Analysis of the quality testing that has been done by using Gas Chromatography method for determining the levels of ethanol and sineol on eucalyptus oil. Based on the analysis of test quality eucalyptus oil as shown in Table 5.

**Table.5.** Quality test of eucalyptus oil

Test Type	Samples I	Samples II	Requirements
Condition			
Color	v	v	Clear to greenish
Smell	v	v	Eucalyptus Typical
The specific gravity (25° C)	0.8491	0.8455	-
Optic Rotation (26.6° C), 200 mm	1.85°	-2.55°	POLAX 2L, Atago
Refractive inde $n^{29.8} D$	1.4640	1.4675	Refraktomer, ABBE
Solubility in etanol 70%	not dissolved	not dissolved	-
The contentsineol(%)	67.569	60,186	GC, external standar

a. The specific gravity

Based on the above table, the results showed the the specific gravity of eucalyptus oil refining traditionally, 0.8491 and 0.8455 for the processing plant. Both the above results when compared with the value of Indonesian national standard the specific gravity values ranging between 0.900 and 0.930, showed a significant difference. This is due to traditional refining, treatment of raw materials eucalyptus leavesis not done. The increase in the value of the the specific gravity is higher with the longer the storage time of eucalyptus leaves is expected because the eucalyptus oil obtained from the distillation of leaves that have been saved will have a constituent component weight fraction which is more and more so that the value of the the specific gravity of the oil will be higher (Khabibi, 2011).

Treatment without stirring and stirring of leaves when storage give different results for the value of the the specific gravity of eucalyptus oil produced. The value of the the specific gravity of eucalyptus oil obtained from the leaves by stirring treatment is higher than the value of the the specific gravity of eucalyptus oil obtained from the leaves without stirring.

b. The refractive index

The refractive index can be determined on the basis of direct measurement of the angle of refraction oil by maintaining a constant temperature conditions. The value of the refractive index of eucalyptus oil or other essential oils can be determined by using a refractometer. The results showed the range of 1.464 (distillation traditional) and 1.467. This value is within the range of 1.450 to 1.470 in the national standard. According to Guenther, the value of the refractive index is also influenced either by the presence of water in the eucalyptus oil content. The more water content, hence the smaller the value of the refractive index. This is due to the nature of the water that is easy to refractin coming light.

c. Optical rotation

Optical rotation eucalyptus oil can be determined by apparatus a polarimeter. Determination of the value of optical rotation eucalyptus oil is based on measuring the angle of the field in which the polarized light is rotated by the oil layer thickness and temperature. Optical rotation is a value obtained from the polarization of light is rotated to the right (dextrorotary) or to the left (laevorotary) by essential oils which are placed in the light or light (Guenther, 1987). Values obtained optical rotation of eucalyptus oil in the study ranged from 1,850 up to -2.550. The range of values obtained from the optical rotation eucalyptus oil meets Indonesian national standard for eucalyptus oil (SNI 06-3954-2006)

d. Sineol Contains

Sineol ( $C_{10}H_{18}O$ ) is the main constituent component of eucalyptus oil in the form of a chemical compound class of terpene alcohol ester derivative contained in eucalyptus oil (Khabibi, 2011). Sineol is a constituent of eucalyptus oil are quite high levels. From the results of assays sineol eucalyptus oil obtained by distilling eucalyptus leaves in this study, the results obtained sineol 60.186% graderange. Sineol content value of this research into the Indonesian National Standard (SNI 06-3954-2006).

From the results of other research, assays sineol eucalyptus oil obtained by distilling eucalyptus leaves get results sineol levels range from 52% to 60% (Khabibi, 2011). However, the results of this study, the content is quite high sineol exceed the value SNI, 67.569% (traditional distillation). If seen that without treatments in eolnya content is high, due to refining long time, 8 hours.

Different distillation process can lead to differences indistillates. There was an unexpected evaporation, these factors are technical factors that occurred during the study. It is caused due to lack meeting continued and the head of the kettle during refining. Warming on eucalyptus leaves can

cause enormous pressure so that the steam generated out bias, hence its large fire in the steam let his guard did not come out. Vapors that come out may contain ethanol, because ethanol is very volatile due to the ethanol boiling point lower than water.

#### 4. Conclusion

From this research, it can be concluded, Average major heat to heat the boilers on the first day and the second day 1371.691499.54 Kcal Kcal. The energy value is so great at providing excellent refining results, obtained by the distillation time for 8 hours in the absence of treatment of the raw material eucalyptus leaves. Results of laboratory analysis showed the quality of eucalyptus oil for refining and processing plant traditionally are quite popular among the public is used to show a significant difference. For sample I (traditional) cineol content of 67.569%, the refractive index of 1.464, 1.850 optical rotation, and of 0.849. For samples II (commercial) content cineol 60, 186%, a refractive index of 1.467, -2.550 optical rotation, and of 0.845.

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