

Superheated Steam Generation Development Using Fuel Biomass at Patchouli Oil Refining Process

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ABSTRACT

Patchouli distillation using process direct steam contact has been done by patchouli community in Indonesia has not been enough to produce the maximum rendement and quality. Rendement with conventional refining raw materials normal conditions ranged from 2-2.5% to the value of Patchouly Alcohol (PA) 30% ~ 32%. The rendement is influenced also by the condition of the raw material. The rendement can be improved through the engineering process. It is assumed that the low rendement is caused by the quality of steam distillation that is at the level of saturation or a mixture so that the energy required for the release of oil bonds in the raw material is not reached maximum. This research purposes to develop a process using superheated steam to improve the quality of steam distillation in an effort to drive the rendement using biomass as fuel. This research has produced a distillation unit with a capacity of 20kg of raw material / batch consisting of boilers with steam drum and superheater facilities, raw material boiler, condenser and oil separator. Distillation test results showed that an increase in the level of the state of the steam out of a boiler into a saturated state with the superheated steam. Steady state in the steam drum and superheater value of each 1,5bar/112°C; bar/140°C and produce to 20kg of raw material obtained under normal conditions rendement 3.1% with 5.5 hour time process.

Key word : Boiler, Superheater, Steam Drum, Superheated Steam, Distilation

INTRODUCTION

Patchouli oil is one of the essential oils produced in Indonesia as well as an export commodity. Some areas are becoming patchouli oil production centers in Indonesia, among others the province of Aceh, north Sumatra, Bengkulu and west Java. Patchouli oil is generally produced by the three methods, namely distillation, extraction, and compression. Distillation method can also be done with medium water, steam or water-steam mixture. Nowadays, most of farmers in Indonesia, steam distillation method is most widely used to the essential oils production. One of reason is simple technology has been proven successfully.

Some of the challenges in the patchouli oil refining process are lower quality and rendement. The highest rendement was be produced by steam distillation method which ranges between 2% - 2.5%. Several studies have been conducted in to increase rendement as following reseached :

- Pina Barus (2008), was perform reseach for 100 kg patchouli leaves with variations in pressure : 1 atm, 1.5 atm and 2 atm. The results showed the highest rendement was achieved 3.25% at pressure 2 atm for 5 hours with patchouly alcohol content of 32.68%.
- Ansar Patria, et al (2008), was perform reseach of the patchouli oil refining with a variation of the vapor pressure of 1 atm, 2 atm and 3 atm. The results obtained the highest rendement 3.93% at a pressure and temperature steam 3 atm (135°C) for 3 hours.

Lower actual rendement than the theoretical rendement is an issue which require to find best solution. Theoretically, patchouli leaves have an oil content 5% ^[5] with a boiling point ranges of chemical component between 54°C-214°C^[6]. Construction equipment of several refining processes was found in the field that the steam state come to raw material boiler at saturated steam. Steam contacted with raw materials take placed at temperature and pressure saturated phase. It is possible that the steam fall down to a liquid phase. That state cuases the raw material is not enough of the energy to be able evaporate all oil components with chemically bound in the raw materials. Saturated steam is not able to push all the chemical components to get out as a distillate. Things this caused rendement low.

In the case of the production of steam, the boiler is the main equipment which is very influence in generated steam. The ability of the boiler to produce certain state steam determine the quality and rendement of distillates. It means need to a good boiler design to improve the quality of steam from the state of saturated steam to dry steam superheated steam.

Based on this case, the study has been conducted with the purposes of developing patchouli oil refining process using superheated steam to increase the distillation quality regarding to rendement and amount of product. In this reseach we used biomassa as fuel energy for generated of steam

RESEARCH METHODE

This research was conducted with the following stages:

1. Equipment testing fabrication

In this phase has designed one unit equipment steam distillation with a capacity of 30 kg of steam/hour to load the raw material 20 kg/batch. Construction equipment layout as shown in Figure 1 below :

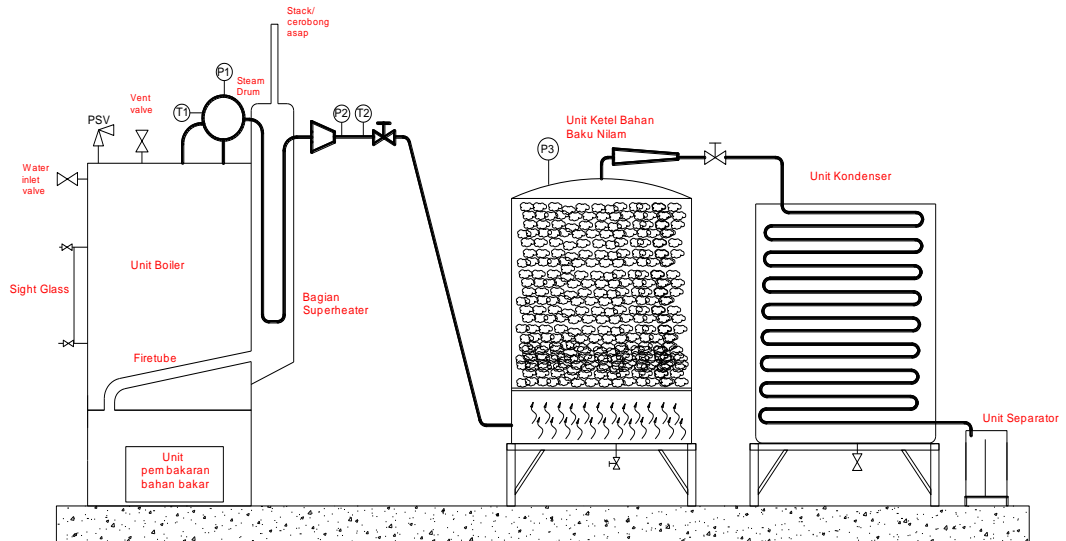


Figure 1. Patchouli oil steam distillation equipment layout

2. Performance test equipment

Performance test was conducted to ensure all of equipment fabricated according to design. The equipment test shown in Figure 2 below :



Figure 2. Performance test of patchouli oil steam distillation equipment

Test points noted refers to measuring instruments installed on equipment as shown in Figure 1 above. The measuring instrument used comprises 1 unit of pressure safety valve, 2 units termowell indicator, 2 units of pressure gage and also 1 unit water level indicator which installed at point measurement following :

- P1 : Steam drum pressure
- T1 : Steam drum temperature
- P2 : Superheated steam pressure come to raw material tank

- T_2 : Superheated temperature come to raw material tank
Patchouli raw materials used in the performance test is normal condition with composition of approximately 30% leaves 70% of the stem as shown figure below :



Figure 3. Patchouli raw material sample for performance test

RESULTS AND ANALYSIS

The results of performance test for load 20 kg of raw material obtained as shown in Table 1 below:

Table 1. Performance distillation test data

No.	Parameters	Unit	Quantity	Remarks
1	Weight of raw material	kg	20	Normal condition (70% stems,30%leaves)
2	Water boiler volume	liter	120	70% vol. boiler space
3	Time of preheating water to 100°C	minute	120	
4	Time of distillation	hours	5.5	
5	Steam drum pressure (P_1)	kg/cm ²	1.5	
6	Steam drum temperatur (T_1)	°C	112	
7	Superheater pressure (P_2)	kg/cm ²	2	
8	Superheater temperatur (T_2)	°C	135	
9	Raw material tank temperature	°C	105	top level location
10	Oil weight produced	kg	0.61	
11	Rendement ratio	%	3.1	
12	Pacholly alcohol value	%	27,45	for 2 hours time distilation
			40,02	for 5 hours time distilation
13	Stack temperatur	°C	140-165	
14	Raw tank wall temperature	°C	80	No insulated
15	Water cooling temperatur	°C	85	Top level water

Regarding to information in the table 1 above, describe that steam state get out superheater (inlet raw tank) is superheated steam. Distillation equipment has been able to generate superheated steam comply with design planned. The test results show rendement of patchouli oil produced is 3.1% with 5.5 hours distillation time. This condition are influenced by the composition of raw materials (30% leaves 70% of the stems), solidity of the raw materials tank and the ability of the separator to separate oil and water (little of oil is founded bound with water).

The value of patchouli alcohol (PA) based on laboratory test indicates values respectively 27.45; 41.69 for sampling with 2 hours and 5.5 hours time distillation. PA value has been proven depend on time distillation.

High temperature exhaust gas on stack possible indicate low heat absorbed by superheater wall in chamber of boiler noted. Superheater pipe configuration have space which losses of heat gas possibility.

CONCLUSION

According to the results of reseach concluded :

1. Performance test boiler shown able to increase the quality of steam distillation from saturated steam to superheated steam has been proven succesfully.
2. Performance test with load capacity 20 kg raw materials (70% stems and 30% leaves) was obtained 0.61 kg of patchouli oil with rendement 3.1%. The rendement influenced by the raw material composition, solidity raw materials in tank and the ability of the separator.

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