



Producing Liquid Smoke Results from Pyrolysis of Waste Acacia (*Acacia Mangum Wild*) and Teak Wood (*Tectona Grandis*) into Organic Pesticides

K. A. Ridwan, Ida Febriana^(✉), M. Anerasari, Andiko Andiko,
and Ajeng Mawarni Putri

Politeknik Negeri Sriwijaya, Jalan Srijaya Negara, Bukit Besar, Indonesia
Ida.febriana@polsri.ac.id

Abstract. Many problems occur in agricultural products, one of which is the presence of residual chemicals that are still contained in plants so that they can endanger the health of humans who consume them continuously. One of the efforts to minimize the use of this dangerous insecticide, the researchers designed a charcoal pyrolysis device that has a by-product of liquid smoke, where this liquid smoke will be made into an insecticide that is not harmful to human health, namely organic insecticides (organic pesticides) produced through the pyrolysis process. Based on the GCMS test there are 34 compounds contained in liquid smoke, Polycyclic Aromatic Hydrocarbon (PAH) compounds in the form of benzene found in liquid smoke products, but with an area of about 0,06% for acacia wood liquid smoke and 0,04% for teak wood liquid smoke so that it can be classified as an organic insecticide (Ministry of Agriculture No 43 of 2019).

Keywords: Organic pesticides · liquid smoke · acacia · teak wood

1 Introduction

Liquid smoke is the result of condensation or condensation of steam resulting from combustion which can be obtained through the pyrolysis process of materials containing cellulose components, acid compounds, hemicellulose, and lignin [1]. The obtained distillate can be further separated to separate unwanted chemical compounds, for example, insoluble tar compounds, using pyrolognic acid. Efforts have been made to date to overcome the existing waste by burning it into charcoal to cause pollution and global warming. However, this increasing number of wood and shell waste can also be used to produce alternative energy with high-value products that are useful for many people through the pyrolysis process which produces 3 forms of substances, including solids in the form of bio-char, bio-oil, and syngas [2]. Efforts have been made to date to overcome the existing waste by burning it into charcoal to cause pollution and global warming. However, this increasing number of wood and shell waste can also be used to produce alternative energy with high-value products that are useful for many people through the pyrolysis process which produces 3 forms of substances, including solids in the form

of biochar, bio-oil, and syngas [2, 3]. Organic waste is one of the many types of waste that is environmentally friendly because it can be reprocessed into something useful if managed properly. There is a very effective method for processing organic waste into economic value, namely the pyrolysis method to produce liquid smoke. Pyrolysis is a chemical decomposition process using heat and a little oxygen. This process is a process to obtain carbon or charcoal. Pyrolysis reactions are generally carried out at temperatures between 150 °C–500 °C with the main product in the form of charcoal and other products in the form of gas and tar [3]. Liquid smoke is one source of natural preservatives produced from condensed smoke resulting from the pyrolysis process. Liquid smoke is a dispersion of smoke vapor in water, the raw materials that can be used as liquid smoke are components containing cellulose, hemicelluloses, and lignin. During the pyrolysis process of cellulose, hemicelluloses and lignin will be decomposed into phenol, carbonyl, acid, furan, alcohol, lactone, and other polycyclic aromatic hydrocarbon compounds [4]. One of the problems with liquid smoke is the components of tar and benzopyrene which are toxic and carcinogenic, so the purification process is the most important factor in liquid smoke products. The purification process is the most important factor in liquid smoke products. Purification of the pyrolysis process is carried out by distillation based on differences in boiling points, has conducted research on liquid smoke purification by redistillation to remove tar, the optimum condition obtained at a temperature of 121 °C–140 °C obtained a yield of 8,8%. The quality of liquid smoke is determined by the composition of phenol, and acid, and the amount of these components is influenced by the operating conditions of the pyrolysis process, namely the pyrolysis temperature and time and the distillation temperature. [5] stated that the maximum content of phenolic, carbonyl, and acid compounds was achieved at a pyrolysis temperature of 600 °C.

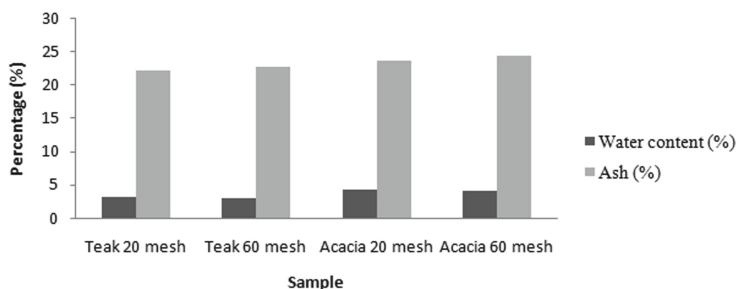
2 Methodology

The research has been carried out at the Chemical Engineering Laboratory of the Sriwijaya State Polytechnic. The main objective of this study was to obtain liquid smoke products from acacia and teak wood chips using the pyrolysis method to be used as an organic pesticide. The main activities of this research are to study the liquid smoke product produced based on the physical standard ASTM D7544 and the chemical standard according to the study [6] and identify volatile components using GC-MS (Gas Chromatography-Mass Spectroscopy Agilent 19009IS 433UI Hp 5 ms Ultra Inert 60 °C–325 °C (350 °C) with hexane solvent. The work steps in this research consist of:

1. Sample preparation [7]. Drying the samples in the sun for 1 day (9 h). Weight the sample to be used.
2. Analysing the characteristics of raw materials by testing the water content based on SNI 01-2891-1992.
3. Production of liquid smoke as soon as possible [3]
4. Product Analysis

Table 1. Sample naming

| Sample | Sample size | Code |
|-------------|-------------|------|
| Teak wood | 20 mesh | A |
| | 60 mesh | B |
| Acacia wood | 20 mesh | C |
| | 60 mesh | D |

**Fig. 1.** Water content and ash of raw materials

- pH analysis with digital pH meter test based on SNI 06-6989.11-2004
- Density analysis with pycnometer based on SNI 01-2891-1992
- Analysis of acid content based on SNI 01-2891-1992
- Phenol analysis by GC-MS (Gas Chromatography-Mass Spectroscopy).

3 Result and Discussion

This study aims to produce liquid smoke resulting from the pyrolysis of acacia wood and teak wood waste into organic pesticides by examining the effect of colour and odour of liquid smoke, liquid smoke yield, and liquid smoke quality based on the physical properties standard ASTM D7544 and chemical properties standards according to [6] and identify volatile components using Gas Chromatography-Mass Spectroscopy (GC-MS), and test the effectiveness of liquid smoke as an organic pesticide. Table 1 shows the naming system for the samples used in this study, namely:

3.1 Analysis Pre-treatment of Raw Material

This value is a value that is quite low and good for the pyrolysis process. According to [6] the criteria for raw materials have a maximum moisture value of 10% of dry weight. Low water content tends to produce higher amounts of phenol, acid, and carbonyl, while wood with higher water content will reduce the content of acid compounds, formaldehyde, phenol, and a lot of mixing of the condensation results from water vapor with liquid smoke so that it will reduce the quality of liquid smoke [7]. The results of the

Table 2. Specifications for the colour and odour of liquid smoke

| Sample code | Color | | Odor | |
|-------------|-----------------------------------|---------------------------------|---------|---------|
| | Phase 1 | Phase 2 | Phase 1 | Phase 2 |
| A | Transparent Brownish Yellow | Transparent Greenish Brow | Medium | Strong |
| B | Transparent Brownish Yellow | Transparent Greenish Brow | Medium | Strong |
| C | Transparent Brownish Yellow | Transparent Greenish Brow | Medium | Strong |
| D | Transparent Brownish Yellow | Transparent Greenish Brow | Medium | Strong |

Note: A: 20 mesh teak, B: 60 mesh teak, C: 20 mesh acacia, D: 60 mesh acacia

measurement of ash content showed a value of 22.2% in 20 mesh teak, 22.5% in 60 mesh teak, 23.9% in 20 mesh acacia, and 24.3% in 60 mesh acacia. The ash content parameter shows the percentage of other ingredients, especially inorganic compounds found in raw materials. The highest ash content is acacia 60 mesh powder with a value of 24.27%. This is due to the content of the sawdust itself. The greater the amount of char that will be produced from the pyrolysis process (Fig. 1).

3.2 Analysis of Colour and Odour Analysis of Liquid Smoke

Based on Table 2, the color and odor of liquid smoke obtained in process pyrolysis at a temperature of 300 °C–500 °C with 5 h, the colors produced from liquid smoke of acacia wood and teak wood obtained in phase 1 are all transparent brownish yellow, and in phase 2 all are colored transparent greenish brow and smell of liquid smoke produced by acacia wood and teak wood for phase 1 all smelled of medium smoke, and phase 2 smelled of acrid smoke. This liquid smoke is classified as grade 2 liquid smoke in phase 1 and grade 3 in phase 2 and after being decanted for a week two layers are formed, the bottom layer is black (tar) and the top layer is transparent brownish yellow in phase 1, and transparent greenish brown in phase 2, after a week the liquid is filtered using filter paper to separate the liquid smoke and tar. Liquid smoke with a sharp odor will produce higher phenol levels because it is influenced by acid levels [1]. Therefore, the sample used for the analysis of Gas Chromatography-Mass Spectroscopy (GCMS) is phase 2.

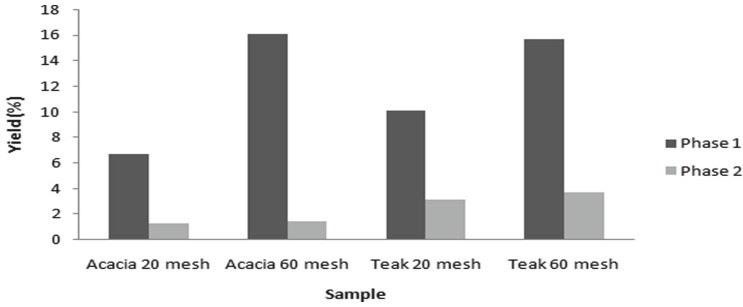


Fig. 2. Product yield value of liquid smoke

3.3 Product Quantitative Analysis

In Fig. 2, the % yield of smoke differs according to the type and size of the raw material. One of the parameters that affect the pyrolysis process in the raw material is (the type of waste biomass used, particle size, and pre-treatment of raw materials). From the results of the research, it was found that the % yield value of 20 mesh teak sawdust had a yield in phase 1 and phase 2 of 6.70% and 1.3%, respectively. Teak wood powder 60 mesh has yields in phase 1 and phase 2 of 6.10% and 1.50%, respectively. Then the raw material of 20 mesh acacia wood powder yielded in phase 1 and phase 2 of 10.1% and 3.1%, respectively. Acacia wood powder 60 mesh had yields in phase 1 and phase 2 of 15.7% and 3.7%, respectively. At a heating temperature of 325 °C, the cellulose smelting process occurs at a temperature of 100 °C–250 °C and hemicelluloses at a temperature of 250 °C–350 °C [8]. The highest yield is found in acacia powder raw material size 60 mesh with a total of 19.40% compared to other raw materials. This is because acacia sawdust contains more hemicelluloses and high cellulose content. The percentage of liquid smoke will increase as the sample size decrease [9]. This can be seen from the liquid smoke yield data obtained from all raw materials, which shows that each raw material with a size of 60 mesh gets more liquid smoke yield than the size 20 mesh. This increase in liquid smoke is due to the smaller size of the raw material, the surface area of the material per unit mass will accelerate the overall heat propagation of the feed which will increase the yield of liquid smoke products [9].

3.4 Product Qualitative Analysis

Liquid smoke that has a low pH indicates the presence of an acid such as carbolic acid [10]. This is because the raw material for sawdust contains cellulose and hemicelluloses which decomposes to produce organic acid compounds [7]. From the results of research conducted when compared with the pH characteristics of liquid smoke in ASTM D7544, all the pH values were obtained to meet the standard, namely pH of 2–3. The low pH value of liquid smoke indicates that liquid smoke has high quality so it can be used as a preservative that can have a high products shelf life [7] (Fig. 3).

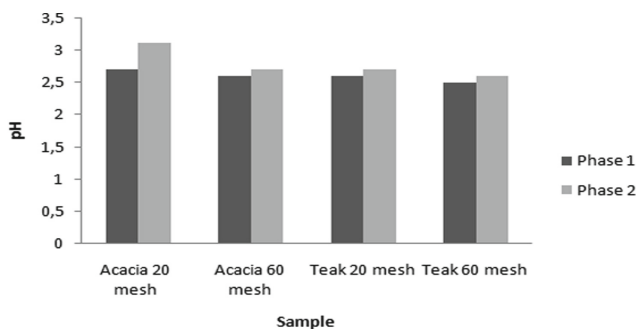


Fig. 3. pH value of liquid smoke

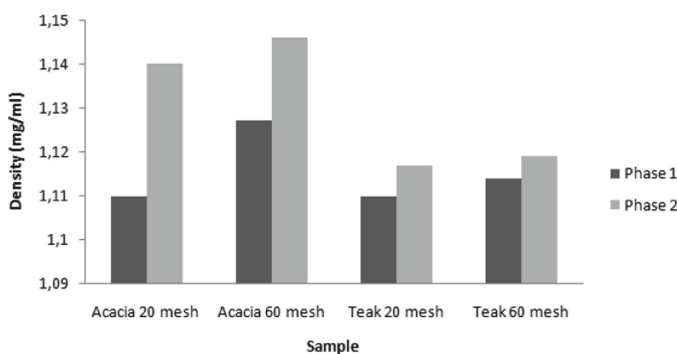


Fig. 4. The density of liquid smoke

The density value in liquid smoke is not directly related to the quality of liquid smoke but shows the constituent components in liquid smoke [3]. The density value obtained in liquid smoke shows that the density value in phase 1 is lower than in phase 2 in all raw materials. This is due to the longer time of the pyrolysis process resulting in smaller hydrocarbon chain bonds, thus making the density decrease [11]. Therefore, it also shows that the constituent components of phase 2 liquid smoke are more than phase 1. The characteristics of the density of liquid smoke according to ASTM D7544 are 1–1.3 gr/ml which of all the density values of liquid smoke obtained meet these standards. One of the density value factors is the water content in the raw material and the length of the pyrolysis time, the longer the pyrolysis time, the more organic compounds such as phenols, organic acid, carbonyl, whereas if it contains a lot of water, the composition of the liquid smoke contains little compounds organic [6] (Fig. 4).

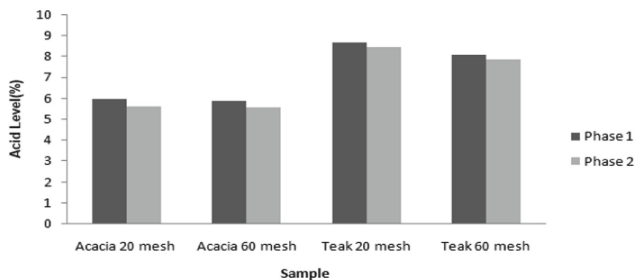


Fig. 5. The acid content of liquid smoke

From the result of the research conducted, the highest acid content was produced by acacia wood powder with a size of 20 mesh in phase 1, which was 8.65%. This is because acacia sawdust contains content such as hemicelluloses and cellulose which decomposes to produce organic acid compounds [9]. It can be concluded that acacia wood has higher cellulose and hemicellulose content than teak. From the results of research that has been carried out when juxtaposed with [6], all the acid levels obtained meet the values that have been studied, namely 2.8–9.5%. The difference in the amount of acid content is due to the organic acids produced from the decomposition of hemicelluloses and cellulose components undergoing a pyrolysis process at a combustion temperature below 300 °C [9] (Fig. 5).

3.5 Gas Chromatography-Mass Spectroscopy (GCMS) Analysis

One of the chemical components that are carcinogenic and can be formed during formed during the pyrolysis process of acacia wood and teak wood is benzo[a]pyrene. In the manufacture of organic pesticides, the formation of benzo[a]pyrene and polycyclic aromatic hydrocarbons (PAHs) will not be a problem. Therefore, it is necessary to identify the components of liquid smoke using Gas Chromatography-Mass Spectroscopy (GCMA) on the obtained liquid smoke products. The magnitude of each component is presented semi-quantitatively by determining the peak area (%) obtained. From the results of the GC-MS analysis of acacia and teak liquid smoke, it identified the presence of components of polycyclic aromatic hydrocarbons (PAHs) or carcinogenic compounds. The decrease in the amount of degradation products is accompanied by an increase in the amount of carbon dioxide and other gases such as ethylene gas which is a starting material for the formation of PAHs [9] (Tables 3 and 4).

Table 3. GC.MS analysis results of teak wood pyrolysis process.

| No | Retention time (minute) | Component | Peak Area (%) |
|----|-------------------------|--|---------------|
| 1 | 3.160 | 2,4-Hexadiyne | 0.25 |
| 2 | 3.188 | 2-Methyl-5H-dibenz[b,f]azepine, 2,4-Hexadiyne, Benzene | 0.38 |
| 3 | 3.359 | 2-Methyl-5H-dibenz[b,f]azepine | 0.45 |
| 4 | 3.596 | Cylotrisiloxane, hexamethyl 1H-Isoindole-1,3(2H)-dithione | 0.15 |
| 5 | 3.658 | 2-Methyl-5H-dibenz[b,f]azepine 1H-Isoindole-1,3(2H)-dithione, 2-ethyl Cylotrisiloxane, hexamethyl | 0.27 |
| 6 | 3.789 | 2-Cyclopentene-1-one, 2-methyl | 4.59 |
| 7 | 3.879 | 2-Ethyl-5-Methylfuran | 1.89 |
| 8 | 3.932 | 2-Methyl-5H-dibenz[b,f]azepine, Bezenamine, 2-[(1-methylethyl)thio]-N-2-propenyl | 0.69 |
| 9 | 3.983 | 2-Methyl-5H-dibenz[b,f]azepine, 2-benzylindole, Cylotrisiloxane, hexamethyl | 0.50 |
| 10 | 4.164 | 1H-Isoindole-1,3(2H)-dithione, 2-ethyl 2-Methyl-5H-dibenz[b,f]azepine, Cylotrisiloxane, hexamethyl | 0.21 |
| 11 | 4.326 | Cyclohexene, 1,2-dimethyl 1-Methylcycloheptene | 0.40 |
| 12 | 4.447 | 1-propoxypropan-2-yl 2-methylbutanoate 3-Buten-2-ol,2,3-dimethyl, Allyl isovalerate | 9.90 |
| 13 | 4.586 | Oxirane, (2-methylpropyl), 5-nonanone 2H-Pyran | 9.86 |
| 14 | 4.652 | 2-dimethylaminoethyl adamantane 1-carboxylate, Cyclohexanol, 1-methyl | 1.00 |
| 15 | 4.697 | 2-Furancarboxaldehyde, 5-methyl | 5.26 |
| 16 | 4.758 | 2-pentene, 2,4-dimethyl Trans, trans-Di(2-oxabicyclo[3,1,0(1,3)hexyl ether | 1.78 |
| 17 | 4.878 | Cyclopropane, methoxymethylene, Methyl 2-furoate 2-furancarboxylic acid, methyl ester | 0.36 |
| 18 | 4.932 | Phenol | 8.68 |
| 19 | 5.053 | Levulinic acid, methyl ester, Pentanic acid, 4-oxo, methyl ester | 0.77 |
| 20 | 5.132 | Cyclopentane, (1-methylethylidene), 1-Isopropyl-1-cyclopentene | 1.12 |
| 21 | 5.195 | 4-octyne 2-cyclopenten-1-one, 2,3-dimethyl | 0.84 |

(continued)

Table 3. (continued)

| No | Retention time (minute) | Component | Peak Area (%) |
|----|-------------------------|--|---------------|
| 22 | 5.247 | x-methyl-x, x-dihydro-(xH)-pyran-x-one, Cyclohexanone, 3-methyl, 3-hexen-2-one, 5-methyl | 0.66 |
| 23 | 5.305 | 2-pentanone, 1-hydroxy Pyrano[3,2-b]pyran-2(3H)-one, hexahydro-,cis- | 3.82 |
| 24 | 5.523 | Bicyclo[3,2,1]octa-2,6-diene, 8-methyl-, anti- | 0.40 |
| 25 | 5.558 | 2-cyclopenten-1-one, 2-hydroxy-3-methyl | 1.21 |
| 26 | 5.702 | 2-cyclopenten-1-one, 3,5,5-trimethyl 1-buten-3-yne, 4-trimethylsilyl | 0.17 |
| 27 | 5.737 | 2-cyclopenten-i-one, 2,3-dimethyl | 1.27 |
| 28 | 5.895 | Phenol, 2-methyl p-Cresol | 4.12 |
| 29 | 6.040 | 2-cyclopenten-1-one, 2,3,4-trimethyl | 0.28 |
| 30 | 6.088 | Acetophenone, Benzamide, N-[6-(2-furyl)-2-oxo-2H-pyran-3-yl] | 0.19 |
| 31 | 6.137 | Phenol, 3-methyl p-Cresol | 6.21 |
| 32 | 6.199 | 4-octyne 3-ethyl-2-cyclopenten-1-one | 0.67 |
| 33 | 6.269 | Propanoic acid, 2-methyl, (4-methoxyphenyl) methyl ester | 0.53 |
| 34 | 6.353 | Phenol, 2-methoxy | 15.19 |
| 35 | 6.423 | 2-ethyl-6, 6-dimethyl-norpinan-3-on 5,6-dimethoxy-3,4-dihydro-1H-quinolin 2-one | 0.38 |
| 36 | 6.546 | Phenol, 2,6-dimethyl 2,5-xylenol | 0.45 |
| 37 | 6.686 | Ethylcyclopentenolone 2-cyclopenten-1-one, 2-hydroxy-3-ethyl | 0.33 |
| 38 | 6.859 | Phenol, 3,5-dimethyl, Phenol 2,4-dimethyl, Phenol 2,5-dimethyl | 0.25 |
| 39 | 6.984 | Phenol 2,6-dimethyl, 2,6-xylenol | 1.49 |
| 40 | 7.186 | Phenol 2-Ethyl, Phenol 2,4-dimethyl, Phenol 2,3-dimethyl | 0.77 |
| 41 | 7.305 | 2,3-xylenol, Phenol, 2,5-dimethyl, Phenol, 2,6-dimethyl | 0.16 |
| 42 | 7.357 | 4-methoxy-2-methylphenol, 2-methoxy-3-methylphenol, Phenol, 2-methoxy—6—methyl | 0.17 |
| 43 | 7.456 | Phenol, 2,4-dimethyl, Phenol, 2,6-dimethyl | 0.28 |
| 44 | 7.501 | Creosol | 4.27 |

(continued)

Table 3. (continued)

| No | Retention time (minute) | Component | Peak Area (%) |
|----|-------------------------|--|---------------|
| 45 | 7.925 | 2,4-dimethoxytolune, Cyclopentan-1-al, 4-isopropylidene-2-methyl, 3-ethyl-2-methoxy-phenol | 0.18 |
| 46 | 8.371 | Benzeneethanol, 2-methoxy, Guaiacol, 4-ethyl | 0.98 |
| 47 | 9.038 | Phenol, 2,6-dimethoxy | 2.47 |
| 48 | 9.885 | 3,5-dimethoxy-4-hydroxytolune, 4-methyl-syringol | 0.80 |
| 49 | 10.556 | 4-ethyl 1-2,6-dimethoxy-phenol | 0.34 |
| 50 | 10.627 | 2-propanone, 1(4-hydroxy-3-methoxyphenyl) | 0.21 |
| 51 | 16.414 | 4-Methoxy-6-methyl-5-nitroisobenzofuran-1,3-dione, 4-Chlorophenyl (2R,6S)-2,6-dimethylpiperidin-1-yl jmethanimine | 0.06 |
| 52 | 16.698 | Cyclotrisiloxane, hexamethyl | 0.03 |
| 53 | 16.827 | Cyclotrisiloxane, hexamethyl, Tris(ter-butylldimethylsilyoxy)arsane | 0.05 |
| 54 | 17.166 | 4-Chlorophenyl (2R,6S)-2,6-dimethylpiperidin-1-yl jmethanimine, Cyclotrisiloxane, hexamethyl | 0.18 |
| 55 | 17.308 | Cyclotrisiloxane, hexamethyl | 0.18 |
| 56 | 17.547 | Cyclotrisiloxane, hexamethyl, Tris(ter-butylldimethylsilyoxy)arsane | 0.50 |
| 57 | 17.684 | Cyclotrisiloxane, hexamethyl, Tris(ter-butylldimethylsilyoxy)arsane | 0.35 |
| 58 | 17.740 | 4-(4-Hydroxyphenyl)-4-methyl-2-pentanone, TMS derivative | 0.11 |
| 59 | 17.969 | Cyclotrisiloxane, hexamethyl, Tris(ter-butylldimethylsilyoxy)arsane | 0.49 |
| 60 | 18.089 | Cyclotrisiloxane, hexamethyl, 1,2-Benzisothiazol-3-amine, TBDMS derivatives | 0.20 |
| 61 | 18.112 | Cyclotrisiloxane, hexamethyl, 1,2-Bis(trimethylsilyl)benzene | 0.05 |
| 62 | 18.169 | 4-Chlorophenyl (2R,6S)-2,6-dimethylpiperidin-1-yl jmethanimine, Cyclotrisiloxane, hexamethyl | 0.05 |
| 63 | 18.247 | (4-Chlorophenyl) 1 (2R,6S)-2,6-dimethylpiperidin-1-yl jmethanimine, Cyclotrisiloxane, hexamethyl 1H-Isindole-1,3(2H)-dithione, 2-ethyl | 0.03 |

Table 4. GC.MS analysis result of acacia wood pyrolysis process

| No | Retention time (minute) | Component | Peak Area (%) |
|----|-------------------------|---|---------------|
| 1 | 3.216 | 1H-Isoindole-1,3(2H)-dithione, 2-ethyl 2-Methyl-5H-dibenz[b,f]azepine Cyclotrisiloxane, hexamethyl- | 0.55 |
| 2 | 3.255 | 3-Hexanone | 0.01 |
| 3 | 3.296 | 2-Hexanone | 8.40 |
| 4 | 3.337 | 3-Hexanol 2-Butanol, 2-methyl- | 7.41 |
| 5 | 3.380 | 4-(4-methylphenyl)-1,3-thiazol-2-yl hydrosulfide 2-Methyl-5H-dibenz[b,f] azepine 1-Pentene, 3-methyl- | 5.96 |
| 6 | 3.474 | 1H-Isoindole-1, 3(2H)-dithione,thyl- 2-Methyl-5H-dibenz[b,f] azepine Cyclotrisiloxane, hexamethyl- | 1.65 |
| 7 | 3.556 | Cyclotrisiloxane, hexamethyl Cyclotrisiloxane, hexamethyl-Tetrasiloxane, decamethyl- | 1.75 |
| 8 | 3.738 | 2-Furancarboxaldehyde, Furfuran Furan, 2,5-dimethyl- | 4.76 |
| 9 | 3.936 | Levoglucosenone (Z)-Penta-2,4-dienoic acid Methylenecyclopropanecarboxylic acid | 1.23 |
| 10 | 4.231 | Propanal, propylhydrazone 1-Ethyl-2-methyl-2-propenyl methyl ether Hexan-2,4-dione, enol | 0.82 |
| 11 | 4.321 | Benzol[f]isoquinoline-9-carbaldehyd Cyclotrisiloxane, hexamethyl- Cyclotrisiloxane, hexamethyl- | 0.94 |
| 12 | 4.529 | 2-Cyclopenten-1-one, 2-methyl- 2-Cyclopenten-1-one, 2-methyl- 2-Cyclopenten-1-one, 3-methyl- | 0.88 |
| 13 | 4.615 | 4-(4-methylphenyl)-1,3-thiazol-2-yl hydrosulfide 2-Ethylacridine (4-Chlorophenyl) [(2R,6S)-2,6-dimethylpiperidin-1-yl] methanimine | 0.81 |
| 14 | 4.885 | 3-Buten-2-ol, 2,3-dimethyl- Thiophene-D1 1,1-Dimethyl-2-propenyl methyl ether | 15.82 |
| 15 | 4.985 | 1-Bromo-7-(tetrahydro-2-pyranyloxy) heptane 1-Bromo-8-tetrahydropyranyloxyoctane Hexane, 2-methyl- | 15.84 |

(continued)

Table 4. (continued)

| No | Retention time (minute) | Component | Peak Area (%) |
|----|-------------------------|---|---------------|
| 16 | 5.090 | 9-Nitrobenzo [4,5] thieno[2,3-b] quin oxaline Furazano [3,4-b] [1,2,4]-triazolo[4,3-d] pyrazine, 5-(2,3-dimethylphenylamino)- 3-Ethoxy-1,1,1,5,5,5-hexamethyl-3-(trimethylsiloxy) trisiloxane | 1.99 |
| 17 | 5.149 | Octadienyl tiglate, 2E, 4E- 2-Pentene,2,4-dimethyl- Hexane, 1,6-dibromo- | 4.83 |
| 18 | 5.253 | Phenol | 4.72 |
| 19 | 5.406 | Cyclotetrasiloxane, octamethyl- Cyclotetrasiloxane, octamethyl- | 1.78 |
| 20 | 5.485 | Benzene, 1-ethyl-3-methyl Benzene, 1,2,3-trimethyl Mesitylene | 1.22 |
| 21 | 5.593 | Mephenmetrazine Octane, 2-methyl- Heptane, 2,4-dimethyl- | 1.17 |
| 22 | 6.068 | Phenol, 3-methyl- p-Cresol Phenol, 3-methyl- | 0.71 |
| 23 | 6.277 | Phenol, 3-methyl- Phenol, 3-methyl- p-Cresol | 1.26 |
| 24 | 6.502 | Phenol, 2-methoxy-Phenol, 2-methoxy- | 1.21 |
| 25 | 17.174 | Cyclotrisiloxane, hexamethyl- Tris (tert-butyldimethylsilyloxy)arsane Cyclotrisiloxane, hexamethyl- | 0.99 |
| 26 | 17.460 | 5,8-Epoxy-15-nor-labdane Cyclotrisiloxane, hexamethyl- (4-Chlorophenyl) [(2R,6S)-2,6-dimethylpiperidin-1-yl] methanimine | 1.63 |
| 27 | 17.531 | Tris (tert-butyldimethylsilyloxy)arsane 2-tert-Butylphenol, tert-butyldimethylsilyl ether Arsenous acid, tris(trimethylsilyl) ester | 0.54 |
| 28 | 17.589 | 2-tert-Butylphenol, tert-butyldimethylsilyl ether Arsenous acid, tris(trimethylsilyl) ester Cyclotrisiloxane, hexamethyl- | 0.57 |
| 29 | 17.751 | Cyclotrisiloxane, hexamethyl- | 1.55 |
| 30 | 17.903 | (4-Chlorophenyl) [(2R,6S)-2,6-dimethylpiperidin-1-yl] methanimine Arsenous acid, tris(trimethylsilyl) ester Cyclotrisiloxane, hexamethyl- | 1.55 |

(continued)

Table 4. (continued)

| No | Retention time (minute) | Component | Peak Area (%) |
|----|-------------------------|---|---------------|
| 31 | 18.212 | (4-Chlorophenyl) [(2R,6S)-2,6-dimethylpiperidin-1-yl] methanimine Cyclotrisiloxane, hexamethyl- 1H-Isoindole-1, 3(2H)-dithione,thyl- | 2.80 |
| 32 | 18.299 | Tris (tert-butyltrimethylsilyloxy)arsane Cyclotrisiloxane, hexamethyl- Cyclotrisiloxane, hexamethyl- | 0.44 |
| 33 | 18.340 | 5,8-Epoxy-15-nor-labdane Cyclotrisiloxane, hexamethyl- Tris (tert-butyltrimethylsilyloxy)arsane | 0.24 |
| 34 | 18.376 | (4-Chlorophenyl) [(2R,6S)-2,6-dimethylpiperidin-1-yl] methanimine 5,8-Epoxy-15-nor-labdane Cyclotrisiloxane, hexamethyl- | 0.05 |

4 Conclusions

From the analysis result, the GCMS test there are 63 compounds contained in liquid smoke for teak wood and 34 compounds contained in liquid smoke for acacia wood, Polycyclic Aromatic Hydrocarbons (PAHs) compounds and the form of phenol found in liquid smoke products of about 8.68% for teak wood liquid smoke and 4.72% for acacia wood liquid smoke so that it can be classified as an organic insecticide (Ministry of Agriculture No 43 of 2019).

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