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Improving Production of Liquid Smoke from Candlenut Shell by Pyrolisis Process Sulhatun Department of Chemical Engineering, University of Malikussaleh, Lhokseumawe City, Aceh, Indonesia Rosdanelly Hasibuan and Hamidah Harahap University of North Sumatera, Medan City, North Sumatera, Indonesia Iriani Department of Chemical Engineering, University of North Sumatera, Medan City, North Sumatera, Indonesia Herman Fithra Department of Civil Engineering, University of Malikussaleh, Lhokseumawe City, Aceh, Indonesia Abstract Purpose � The purpose of this research is to study the process conditions that give best yield and expected compositions of liquid smoke products that result during the pyrolisis process relying on predetermined variables.

Design/Methodology/Approach � Pyrolisis process running times are varied, that is, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, and 6 hourly. Condensing temperature maintained remained 25�30 �C. Products identi?cation was applied by using gas chromotography mass spectroscopy. Findings � Ba sed on t h e r esear ch ou tp u t, i t was co ncl u d ed th at p ro cess co nd i ti o ns whi ch g i v e ma x im um y i el d were achieved whe n using do uble unit co ndenser (DUC) a nd t im e o pt io na l fo ur hours, and it provides m aximum v ol u me l i q ui d smo ke p r od u ct, an d co mp osi ti o ns o f p y ro l isi s p r od u cts.

Th e p ro cess al so crea ted sev en com po nent s, namely nept ha lene, propano ic a cid, 3,7 na no diena, 2 met ilguaiakol, 2-met oksi 4 -methyl phenol, 4 et hyl-2 met oksil pheno l, oxyba nzene. A pplying DUC during condensa tion pha se may increase co ndensing fo rce th er eaft er ob ta in i n g resu l ted p r od uct s b etween 20 0% an d 30 0% ra th er th an u si ng si n g le un i t c on den ser (S UC) .

Research Limitations/Implications � This research was conducted on a ?xed batch reactor made of a metal plate with a thickness of 3.0 mm. It carries 200 kg in capacity. In this phase, the moisture of candlenut shells might be kept in 10�12.5% wt. Process temperature applied ranged within 350�500 �C. The authors would like to thank and respect the Department of Research and Technology of Indonesia and KEMENRISTEK DIKTI, who have contributed and supported this research ? nancially, thereby accomplishing this research accordingly. � Sulhatun, Rosdanelly Hasibuan, Hamidah Harahap, Iriani, Herman Fithra.

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110 8/ 9 78- 1- 78 75 6- 79 3- 1 - 00 056 Originality/Value � In addition the study increased the theorical of understanding about pyrolisis process and Improving the production of liquid smoke from candlenut shell by pyrolisis process using the method of vapor condensation (Double unit condensor). Keywords Candlenut shell, liquid smoke, pyrolisis, single unit condenser, double unit condenser All papers within this proceedings volume have been peer reviewed by the scienti ? c committee of the Malikussaleh International Conference on Multidisciplinary Studies (MICoMS 2017). 1.

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Introduction Hazel nut or candlenut (Aleurites moluccana) is classi?ed as one of the huge available natural resources in Indonesia, being considered as a wide prospect marketing commodity both in domestic and overseas. Candlenut shell resulted from its plantations is claimed as one of the numerous solid waste biomass, containing organic compounds, such as hemicelluloses, cellulose, and lignin. Utilizing waste of biomass as the source of bio oil or liquid smoke thorough pyrolisis are commonly used.

Thus, by using several raw materials, such as coconut shells (Haji et al., 2007), palm stems, empty fruit bunches of palm (Fahlepy and Suwardin, 2015), palm shell, saw dust, straw, wheat, grass (Bridgwater, 2010), pine nut shells (Darmadji, 1996), jatropha seeds, Karanja Niger seeds (Purnima, 2012), pine woods, corn cob (Chen et al., 2 01 6) , d a te seeds, coconut husks, plum seeds, waste residue, etc.

However, utilizing solid waste materials from candlenut shells to be processed resulting liquid smoke through pyrolisis process are reported never applied. C har ac te r is ti c of py r oli si s pr o duc ts c ons is ti ng of li quid s mo ke a s a pr im e p r oduc t, b io c har as a so lid st ate pr o duc t r e sul te d in tar a nd ga s (She net al ., 201 5) . H er e af t e r , c o mp o si t i o n s g ai n e d b y bi om as s pyr o lis i s pr oc e ss ar e cl as si?ed by i ts c he mi ca l pr os pe r it ie s, thus phen ol, ca r boni l c om poun d, for m al deh yde, a ci d c om pou nd, and h ydr o po li si kli s a r om at is (HP A) s uch as be nz o (@) pyr e ne in w hic h cl ai me d badne s s due t o ca r si noge ni c for m e d i n w o od pyr o lis is pr oc es s .

Liquid smoke has potential use for all natural antimicrobial in commercial aplication where smoke ?avor is desired, which uses in food aplication (Saloko et al., 2014; Soazo et al., 2016), because liquid smoke memiliki manfaat sebagai antihydroxidative and antimicrobial (Ricke- and Crandall, 2014). The smoking of meat has been used as a presentitative technique for centuries (Kan et al., 2015). Redestillasi liquid smoke from oil palm shell has been proven effective as fresh ?sh preservative due to its antibacterial activity (Chen and Lin, 2015).

Latex coogulant is one of the important factor of natural rubber because it will deremine the quality of rubber end product. One of the coogulant which produces good quality natural rubber is liquid smoke (Fahlepy and Suwardin, 2015). The purpose of this research was to ?nd out (i) treatment procedures which result in best yield, (ii) composition of of liquid smoke yielded from pyrolisis process using predetermined variables, and (iii) the effect of double unit and single unit condenser (SUC) on yield improvement of liquid smoke using pyrolisis process.

2.

Materials and Methods This r es ea r ch c onduct ed in se ver al sta ges , s tar ting fro m ra w mat er ial pr epar ati on (c andle nut s he ll) t h at w as h ar v e st e d f r om s e ve r al v illa g es p la n t at ion s w it hi n N o rt h A ce h d is t r ic t . 2.1. Raw material preparation The raw material is using candlenut shell. This is collected by locals from several villages in north Aceh resort. It is dried naturally by sun to reduce moisture content around 10�15% (Figure 1). Proceedings of MICoMS 2017 144 2.2.

Pyrolisis Stage Methode In this phase, dried candlenut shells to be weighed at 200 kg and fed into pyrolisis tube of reactor which is made up of metal plate with thickness in 3 mm. In this stage, humidity of candlenut shells should be kept at 10�12.5% and not to be crushed to smaller size as it has been appropriately sized. Process temperature maintained within 350�550 �C. Time of pyrolisis presets, that is, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, and 6 hourly. Pyrolisis equipments to be used are SUC and double unit condenser (DUC) intended to observe comparatively the effects of both condensers upon condenser increasing ef?ciency of pyrolisis products obtained. Hereafter, the products collected into storage tank. Condensing temperature to be kept at 25�30 �C.

The next step is to identify the products by using gas chromotography mass spectrometry (GCMS). Calibration of area chromatoghraphy to be done by analyzing response factors over chemical group appearances which ?rstly determined by using campuran standard and senyawa reference (untuk cairan Tetraline untuk gas methane) with a very concentrations. Unidenti?e d p e ak s o f c hr o m at o g r a p h y . Figure 2 covers a 5% of total area presented by average response factor. Characteristic of Figure 1. The Raw Material of Candlenut Shell Figure 2.

The Schematic Diagram of Candlenut Shell Pyrolisis Process Using Fix Batch Reactor DUC and SUC Production of Liquid Smoke 145 liquid products may observed by using Carlo Elba EA 1108 that equipped with elemental microanalyzer. By this instrument, a liquid smoke�water mixture can be observed (Carl Fische Technic, Iram 21320). Calorie value of liquid product�gas mixture to be corrected depending on water content calculated by Dulong�s m et ho d (F i gu r e 2) . 2.3. Product analysis stage Hence we undertook the identi?cation of liquid smoke product yielded by optimum condition and evaluated the characteristics of the product with several variables. GCMS was applied in identifying products. Moreover, analyzing stage was followed by measuring acidity. 3. Results and discussion 3.1.

Result 3.1.1. Pyrolisis Condition. Optimum process condition on candlenut shells resulting maximum gain of liquid smoke by pyrolisis, by applying vapor condensing method, using DUC and SUC with running time 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, and 6 hourly. It shown in Figure 4, where best performance of pyrolisis process to achieve maximum quantity of liquid smoke derive from candlenut shells resulted by using DUC within running time four hours and for SUC within 3.5 hours. 3.1.2 A ?ection of condenser� s types upon increasing yield of liquid smoke.

Op tim u m p ro ce ss c onditions r es ulting ma xi mum l iquid sm oke pr oduc t in pyro lysi s of ca ndlenut s hell s by applyi ng vapo r c ondens ing me thod of SUC that ta kes pyr olys is r unning tim e four hour s. Bes t per fo rm anc e pro ce ss c onditio ns achi eve d by a pplying DU C wi th r unning time fo ur hour s in w hic h tota l yi eld of liquid sm oke obtai ned ar ound 1 ,32 0 m L. It is c le ar ly s how n i n F igur e 3. Figure 3.

Graph Effect Condensor SUC and DUC Serta Proceedings of MICoMS 2017 146 The percentage increase of the candlenut shell liquid smoke products using double-type condensor showed signi?cant in?uence towards smoke liquid production compare to using single-type condensor. The increase reached 300%. It can be seen in Figure 3. 3.1.3. Product Analisa Stage. Analisa identi?cation of the product by GCMS dapat dilihat pada Table 1. 3.2. Discussion Optimum process condition on candlenut shells resulted in maximum gain of liquid smoke by pyrolisis, by applying vapor condensing method using DUC and SUC with running time 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, and 6 hourly.

It is shown in Figure 4, that the best performance of pyrolisis process to achieve maximum quantity of liquid smoke derived from candlenut shells resulted by using DUC within running time of four hours and for SUC within 3.5 hours. Table 1. Nama Senyawa Hasil Pyrolisis Pada Kondisi Optimum Produk Pyrolisa asap Cair Tempurung Kemiri No. Name Komponen % Area 1 Oxybenzene 2,36 2 Propanoic acid 2.26 3 2-Methoxy phenol 73,44 4 2-Methoxy-4-methyl-phenol 13,05 5 8-Methyl-3,7-nonadien-2-one 3.12 6 4-Ethyl-2-methoxy-phenol 2.58 7 Naphthalene 3,19 100 Figure 4.

Effect Time n Type Kondensor upon Liquid Smoke Product Production of Liquid Smoke 147 Analisa Identi?cation of The product by GCMS can be seee in Table 1. The compositions of pyrolisis liquid smoke obtained are also created seven components, namely nepthalene, propanoic acid, 3,7 nanodiena, 2 metilguaiakol, 2-metoksi 4-methyl phenol, 4 ethyl-2 metoksil phenol, oxybanzene. Dari gra?k diatas juga dapat dilihat kandungan atau persen fenol yang tinggi terdapat pada asap cair tempurung kemiri sebesar 73,44%. 4.

Conclusion From this research, the conclusion can be described as follows: The best process condition for maximum performance of liquid smoke during pyrolisis of candlenut shell with condensing vapor method was by using SUC at 3.5 hours and DUC at 4 hours, respectively, which obtained total yield araound 456 mL and 13,200 mL, pH 4.23� 4.78 condensing mechanism using the type of condensor DUC obtained liquid smoke product is higher than using the type of condensor SUC.

The increasing percentage liquid smoke candllenut shell was obtained by using DUC to 300%. Identi?cation of products by using GCMS at optimum conditions shows that liquid smoke candlenut shell consists of components such as oxybenzene 2.36%, propanoic acid 2.26%, 2-methoxy phenol 73,44%, 2-methoxy-4-methyl-phenol 13.05%, 8-methyl-3,7- nonadien-2-one 3.12%, 4-ethyl-2-methoxy-phenol 2.58%, and dan nepthalene 3.19%. References Achmady, S.S., Mubarik, N.R., Nursyamsyi and Septiaji. (2013).

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