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Physical Properties of Orange Peels Eco-enzyme: One way to Reduce and Recycle Waste and Environmental Problem

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ABSTRAK. A high quantity of organic waste without proper waste management can endanger public health and environmental sustainability. To reduce the risk that can be caused by organic waste pollution, then there should be a solution. One of them is to make eco-enzyme. Eco-enzyme is a fermented solution from organic waste that can be used as floor cleaner, plant disinfectant, hand sanitizer, plant fertilizer, etc. In this study, other physical properties of eco-enzyme are analyzed. Here, sunkist orange peel and various mixtures of orange peel were used as the main materials of eco-enzyme. The eco-enzyme solutions were carried out for 33 days, accompanied by routine monitoring of physical parameters such as pH, Total Dissolved Solid (TDS), and Electrical Conductivity (EC) values. The results showed the characteristics of the eco-enzyme product by physical properties are the eco-enzyme has an acidic with a low pH value (<3.6) accompanied by high values of TDS (>1000 ppm) and EC (>1500mS/cm). The finding is TDS and EC have high value whereas usually high EC and TDS are owned by polluted liquids.

KATA KUNCI: eco-enzyme, orange peels, pH, electrical conductivity, total dissolved solid

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1. Pendahuluan

Waste is one of the main problems faced by many cities in Indonesia. Referring to the statement of the Ministry of Environment and Forestry (KLHK) (2020), the total national waste production reached 67.8 million tons with 185,753 tons of waste per day. The biggest contribution of the total national waste production is organic waste which reaches 57% of the total waste production in Indonesia. The amount of organic waste that is abundant in Indonesia is not accompanied by good waste management, where most of the organic waste management is carried out by hoarding waste which can have a negative impact on the environment and public health because organic waste that is stockpiled in the landfill will go through an anaerobic decomposition process that can produce gas, methane. Methane gas is a greenhouse gas that can trap heat 30 times more effectively than carbon dioxide. In addition, this methane gas can endanger public health because it can reduce the composition of oxygen in the air (Larasati et al., 2020). The presence of excess methane gas can also endanger the safety of residents, such as in the case of methane gas explosions. In addition, the accumulation of garbage can have an impact, such as damage to the aesthetics of the environment and other sources of disease, such as diphtheria, diarrhea, and dengue fever. In order to support the government's target of reducing national waste by 30% and waste handling by 70% by 2025, as well as achieving the 12th Sustainable Development Goals (SDGs) on responsible consumption and production, a new approach is needed relating to the management of organic waste that minimizes risks and also provides benefits for the environment and society, one of which is through the eco-enzymes.

Eco-enzyme is a liquid extract of complex organic substances resulting from the fermentation of vegetable or fruit residues with brown sugar or molasses as a substrate, and water (Luthfiyyah et al., 2010). In the production process, the findings of Dr. Rosukon Poompanvong in 2003 is almost the same as the composting process, except that water is added as a growth medium. Furthermore, the final product obtained is in the form of a dark brown liquid and has a strong fresh acid aroma, which in its utilization will be easier to use and has many benefits (Luthfiyyah et al., 2010). In contrast to composting, eco-enzyme production does not require a large area for the fermentation process and a composter bath with certain specifications, but only a plastic container with a tight lid is needed. The final product of eco-enzyme is in the form of suspended residue and fermented liquid. The residue can be used as organic fertilizer residue (contains NO_3 and CO_3 to fulfill plant nutrition), while the liquid product can be used as floor cleaner, disinfectant (contains acetic acid which effectively kills germs, viruses, and bacteria), insecticides, enhancers air and water quality, and sewer cleaners. In addition, eco-enzymes also provide benefits for the environment, where during the fermentation process, O_3 (Ozone) gas is produced.

The production of eco-enzyme as one of the organic waste treatment systems has been applied by Rochyani et al. in 2020 using pineapple (*Ananas comosus*) and papaya (*Carica papaya L.*) which showed that eco-enzyme products that produced for 3 months had acidic properties with a low pH. In addition, the application of molasses in the eco-enzyme manufacturing process causes an increase in the measured pH and TDS values. Another study conducted by Hemalatha et al. in 2020 conducted a trial of eco-enzyme with the basic ingredient of orange peel. This study showed that planting accompanied by the addition of eco-enzymes into the soil media made chilli and aloe vera grow faster than planting without using eco-enzymes in the soil.

There are so many benefits from eco-enzyme but lack of information control by physical properties. Therefore, this study identified the physical properties of eco-enzyme using pH, EC and TDS parameters.

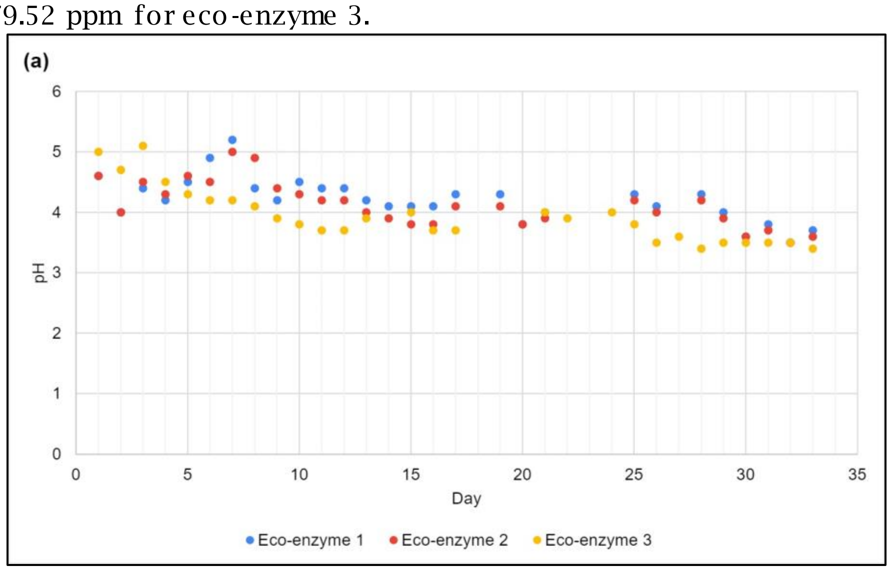
2. Methods

The eco-enzyme are made of some materials: organic waste (this research use Sunkist and mix orange peel in good condition, not gummy, not rotten, not dry, not caterpillar), brown sugar/ molasses/ molasses, and tap water (Eco-Enzyme Nusantara, 2020). The process of making eco-enzymes is carried out by putting small pieces of brown sugar, organic waste, and water into a plastic container with the comparison 1 : 3 : 10 for each material. The plastic container is tightly closed and left for 3 months for fermentation to produce eco-enzyme products in the form of liquid and residue, but in the first week the gas inside the container has to be monitored by open the container lid. At the end of 3 months, the brown eco-enzyme liquid indicates the product has been successfully made and is ready to be harvested.

In this study, we made three containers of eco-enzyme. The first container is made of Sunkist orange peel (eco-enzyme 1). The second and third containers consist of mixed orange peel (eco-enzyme 2 and eco-enzyme 3). The third container was made to prevent the unsuccessful the second container of eco-enzyme. Moreover, during the fermentation process of eco-enzyme, the physical properties were measured. The physical properties consist of acidity (pH), Electrical Conductivity (EC), and Total Dissolved Solid (TDS). The Hanna Combometer HI9813-6 is used for the measurement of physical properties. The physical properties of eco-enzyme were measured every day until 33 days. After 33 days, there are no significant changes in physical properties.

3. Results

The results of pH measurement for the three products of eco-enzyme showed a decreasing trend of pH with a range value for eco-enzyme 1, eco-enzyme 2, and eco-enzyme 3 are 5.2 – 3.5, 3.5 – 5.0, and 3.4 – 5.1. The average value of pH is 4.21 ± 0.36, 4.13 ± 0.37, and 3.93 ± 0.45 for eco-enzyme 1, eco-enzyme 2, and eco-enzyme 3, respectively. The EC measurement shows an increasing trend with a range value is 1547 – 2919 μS/cm and an average is 2343.25 ± 305.66 μS/cm for eco-enzyme 1, 1917 – 3621 μS/cm with an average value is 3033.82 ± 459.45 μS/cm for eco-enzyme 2, and 1554 – 3384 μS/cm with an average value is 2708.89 ± 355.75 μS/cm for eco-enzyme 3. The TDS measurement results for three products of an eco-enzyme show an increasing trend with a range value is 773 – 1459 ppm and an average value is 1193.71 ± 165.09 ppm for eco-enzyme 1, 869 – 1810 ppm with an average value is 1492.32 ± 250.66 ppm for eco-enzyme 2, and 777 – 1692 ppm with an average value is 1360.86 ± 179.52 ppm for eco-enzyme 3.



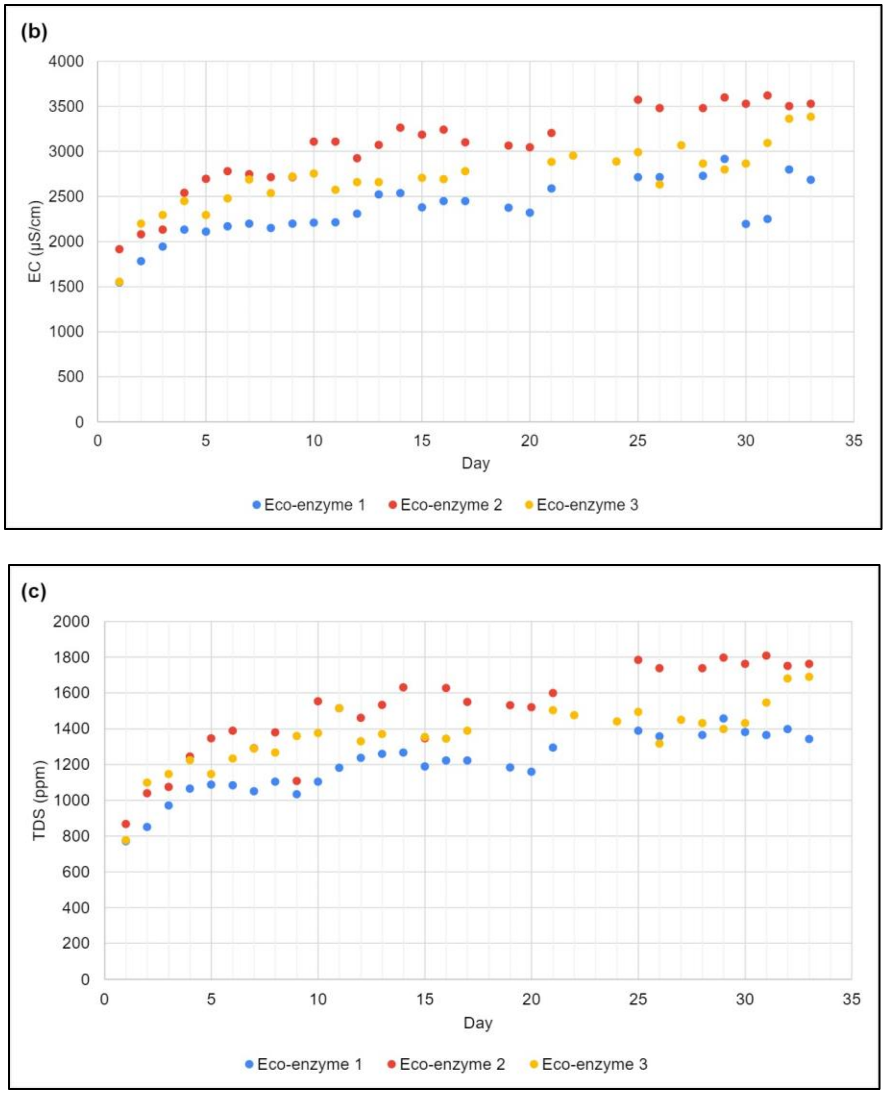


Figure 1. Changes in (a) acidity (pH), (b) Electric Conductivity (EC), and (c) Total Dissolved Solid (TDS) for three eco-enzyme products from day 1 until day 33. The green dot shows the pH measurement results for the eco-enzyme 1, the blue point shows the pH measurement result for the eco-enzyme 2, and the yellow point shows the pH measurement result for the eco-enzyme 3.

During 33 days of monitoring, the result shows a decreasing trend of acidity (pH) or can be said to be more acidic (see Figure 1a). The results of monitoring the EC and TDS parameters for 33 days showed an upward trend or it could be said that the EC and TDS parameter values were getting higher (see Figure 1b and Figure 1c).

4. Discussion

The trend of decreasing levels of acidity in eco-enzyme solutions (more acidic) is thought to occur as a result of the influence of organic acid content in a solution, where the higher the organic acid content, the more acidic the solution (Rohyani et al., 2020). Sunkist or any orange peel have a chemical composition in the form of citric acid. Citric acid is one of the high organic acids that affect the low pH value of the eco-enzyme solution obtained (Etienne et al., 2013). In addition, the degree of acidity (pH) obtained is also influenced by the fermentation process, where microorganisms as fermentation agents consume nutrients in the form of sugar in the solution, produce organic acids and make the pH value lower (acid).

The results of observing the eco-enzyme solution for 33 days showed that the water in the eco-enzyme solution evaporated before the fermentation occurred due to the influence of ambient temperature. This causes an increase in total dissolved solids (TDS) due to a reduction in the amount of water in the solution (Destriyani, et al., 2014). In addition, the increase in the TDS factor was also influenced by organic matter and molasses used as a substrate in the fermentation process in an eco-enzyme solution (Selvakumar, 2015). The TDS value is associated with the number of ions in a solution as a conductor of electric current, where an increase in the TDS value also increases the number of ions in the solution so that the electrical conductivity or EC value will increase (Irwan, 2016). The results of the observation of the degree of acidity, EC, and TDS on the last day of observation (day 33) showed low or acidic pH values (Figure 2) accompanied by high EC and TDS values for the three eco-enzyme products (Figure 3). After 33 days, the pH shows no significant changes in value. This is due to the eco-enzyme solution has is acidic-saturated.

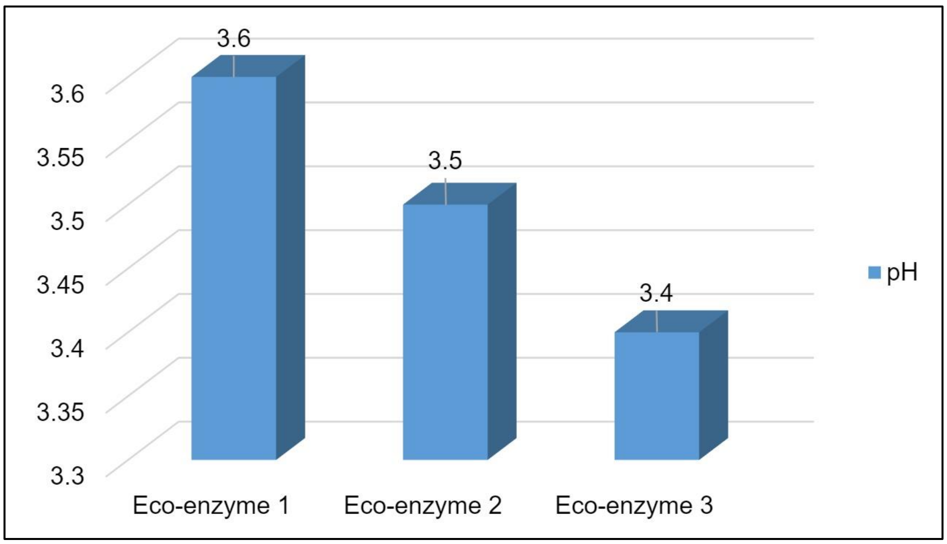


Figure 2. Degree of acidity (pH) for the three fermented solutions of eco-enzyme 1, eco-enzyme 2, and eco-enzyme 3 on day 33

The high value of EC and TDS in eco-enzyme solution is in contrast to the fact that the high value of EC and TDS is proportional to high pollutants in the solution. Based on WHO (1993), for the hygiene-sanitation, the limit of EC is 1500 μS/cm (red dash line in Figure 3) and TDS is 1000 ppm (red dash line in Figure 4). This finding shows for the solution that produced from organic waste, it is possible to have a high value of EC and TDS, not as a pollutant solution but as a fermented organic waste solution.

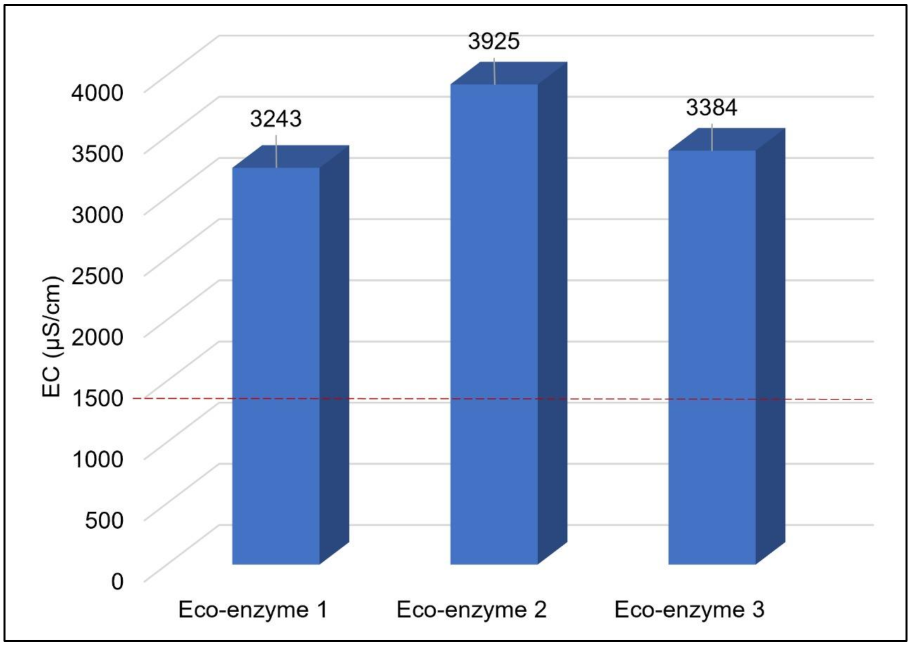


Figure 3. Electrical Conductivity (EC) values for three fermented solutions of eco-enzyme 1, eco-enzyme 2, and eco-enzyme 3 on day 33. The red dashed line shows the limit EC of pollutants based on WHO (1993).

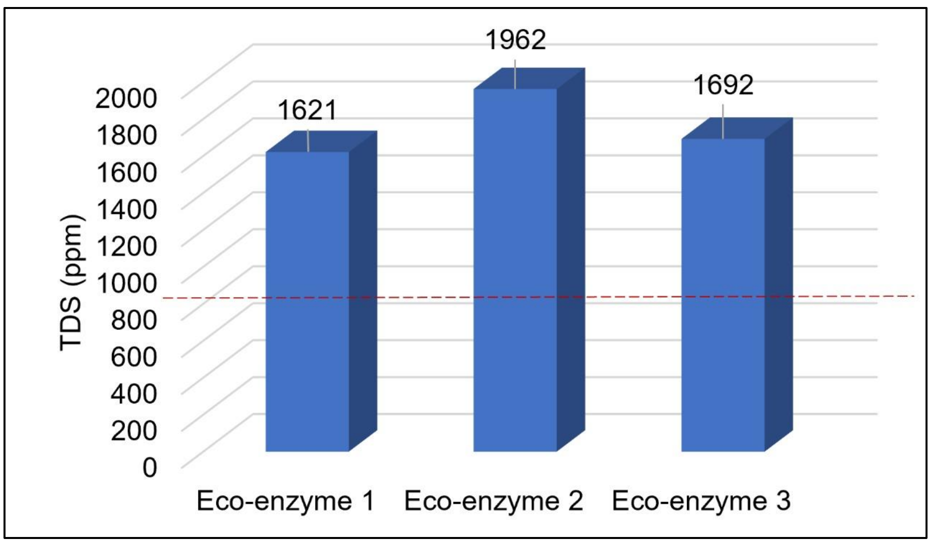


Figure 4. Total Dissolved Soild (TDS) values for three fermented solutions of eco-enzyme 1, eco-enzyme 2, and eco-enzyme 3 on day 33. The red dash line shows the limit TDS of pollutant based on WHO (1993).

5. Conclusion

Eco-enzyme products with basic ingredients of Sunkist orange peel and a mixture of various orange peels after fermentation and monitoring for 33 days have acidic characteristics with a pH value of <3.6 which is thought to be due to the effect of nitric acid content of fermentation. The TDS values of the three eco-enzyme products showed high values, this was due to evaporation that occurred during the fermentation process and the influence of temperature and not because the presence of pollutants in the solution. Nevertheless, the EC values for the three eco-enzyme products have high values, ranging from >3243. The EC value is directly proportional to the TDS value, where the number of electrically conducting ions is directly proportional to the TDS content in a solution.

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Authors Contribution

MAB, KAP dan MS melakukan analisis data dan menulis manuskrip original. KHK dan EA memberi gagasan pokok ide penelitian, merancang penelitian dan melakukan analisis data. DF, MUH dan AS menulis manuskrip revisi.

References

Alkadri S.P., Asmara K.D. Pelatihan Pembuatan Eco-Enzyme Sebagai Hand sanitizer dan Desinfektan Pada Masyarakat Dusun Margo Sari Desa Rasau Jaya Tiga Dalam Upaya Mewujudkan Desa Mandiri Tangguh Covid-19 Berbasis Eco-Community. *Buletin Al-Ribaath.* 2020; 17(2): 98-103.

Destriyani L. Effect of Saving Age From Sugarcane's Water Storage Life to Sweetenestlevel of Sugarcane'Water. *Jurnal Teknik Pertanian Lampung.* 2014;3(2):142387.

Eco-enzyme Nusantara. Modul Belajar Pembuatan Ecoenzym. Nusantara Bersama Kita. 2020.

Etienne, A., Genard, M., Lobit, P., Mbeguie-A-Mbeguie, dan Bugaud, C. 2013. *What controls fleshy fruit acidity? A review of malate and citrate accumulation in fruit cells.* Journal of Experimental Botany, Vol. 64, No. 6, pp. 1451–1469, 2013.

Etienne A., Génard M., Lobit P., Mbeguié-A-Mbéguié D., Bugaud C.. What controls fleshy fruit acidity? A review of malate and citrate accumulation in fruit cells. *Journal of experimental botany*. 2013; 64(6): 1451-69.

Hemalatha, M., dan Visantini, P. 2016. *Potential Use of Eco-Enzyme for The Treatment of Metal Based Effluent.* The Third Bioprocessing and Biomanufacturing Symposium 2019. doi:10.1088/1757-899X/716/1/012016

Hemalatha M, Visantini P. Potential use of eco-enzyme for the treatment of metal based effluent. *IOP Conference Series: Materials Science and Engineering*. 2020; Vol. 716(1); p. 012016.

Irwan F., Afdal A. Analisis hubungan konduktivitas listrik dengan Total Dissolved Solid (TDS) dan temperatur pada beberapa jenis air. *Jurnal Fisika Unand*. 2016; 5(1): 85-93.

Kerkar S.S., Salvi S.S. Application of eco-enzyme for domestic waste water treatment. *International Journal for Research in Engineering Application and Management*. 2020; 5(11): 114-6.

Larasati D., Astuti A.P., Maharani E.T. Uji organoleptik produk eco-enzyme dari limbah kulit buah (studi kasus di Kota Semarang). *EDUSAINTEK*. 2020; 4.

Luthfiyyah, A.P.Y.S., Farabi, A. Konsep Eco-Community Melalui Pengembangan Eco-Enzyme Sebagai Usaha Pengolahan Sampah Organik Secara Tuntas Pada Level Rumah Tangga. 2010 *Kemampuan Koneksi Matematis (Tinjauan Terhadap Pendekatan Pembelajaran Savi)*; 53(9); 1689–1699.

Mavani H.A., Tew I.M., Wong L., Yew H.Z., Mahyuddin A., Ahmad G.R., Pow E.H. Antimicrobial efficacy of fruit peels eco-enzyme against Enterococcus faecalis: an in vitro study. *International Journal of Environmental Research and Public Health.* 2020; 17(14): 5107.

Rochyani, N., Utpalasari R.L., Dahliana I. Analisis hasil konversi eco enzyme menggunakan nenas (Ananas comosus) dan pepaya (Carica papaya L.). *Jurnal Redoks*. 2020; 5(2): 135-40.

Selvakumar P, Sivashanmugam P. Optimization of lipase production from organic solid waste by anaerobic digestion and its application in biodiesel production. *Fuel Processing Technology*. 2017; 165: 1-8.