Produksi bio-oil dari kombinasi bonggol jagung dan limbah plastik menggunakan metode slow co-pyrolysis = Bio oil production from combination of corn cobs and plastic wastes by slow co-pyrolysis

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Abstrak

Fast pyrolysis biomassa dapat menghasilkan bio-oil dengan potensi aplikasi yang luas, salah satunya dapat digunakan sebagai bio-fuel. Sayangnya, bio-oil berbasis biomassa memiliki sifat fisikokimia yang buruk dan banyak mengandung senyawa oksigenat sehingga heating value-nya rendah. Plastik diketahui memiliki rasio H/C yang lebih tinggi dan miskin akan oksigen sehingga slow co-pyrolysis biomassa dengan plastik dapat digunakan sebagai solusi upgrading bio-oil yang sederhana, efektif dan murah. Dengan mencampurkan keduanya, sebuah efek sinergetik akan tercipta untuk memperbaiki kuantitas dan kualitas bio-oil yang dihasilkan.

Bonggol jagung dipilih sebagai biomassa karena kandungan total selulosanya yang tinggi dan ketersediaannya yang melimpah di Indonesia. Bonggol jagung akan dipirolisis bersama-sama dengan plastik polipropilena dalam reaktor batch berpengaduk dengan variasi rasio plastik dalam umpan sebesar 12,5%, 25%, 37,5%, 50%, 62,5%, 75%, dan 87,5%. Kondisi operasi dengan suhu maksimum sebesar 500oC, laju alir N2 sebesar 0,5 L/menit, holding time 10 menit dan heating rate 5oC/menit digunakan selama eksperimen berlangsung. Terjadi peningkatan pH, densitas, dan warna pada bio-oil hasil slow co-pyrolysis. Karakterisasi GC-MS menunjukkan penurunan senyawa oksigenat di dalam bio-oil berbanding lurus dengan komposisi plastik dalam umpan. Efek sinergetik teramati saat rasio plastik 50%. Komposisi umpan 12,5% bonggol jagung dan 87,5% plastik PP menghasilkan yield tertinggi dengan kandungan senyawa oksigenat terendah.

.....Fast pyrolysis of biomass produces bio-oil with many potential applications, one of them is to be bio-fuel. Unfortunately, biomass derived bio-oil has low physicochemical properties and contains lot of oxygenated compounds thus the heating value is low. Plastics are known to have higher H/C ratio and almost no oxygen content, so co-pyrolysis of biomass and plastic could be used as a simple, effective yet cheap bio-oil upgrading solution. By mixing those two as a feed, a synergetic effect will occur and improve the bio-oil both in quantity and quality.

Corn cobs are chosen as the biomass due to its high cellulose content and availability. Corn cobs will be slow co-pyrolyzed with polypropylene plastic in a two stirrer batch reactor with plastic ratio variation of 12,5%, 25%, 37,5%, 50%, 62,5%, 75%, and 87,5%. Maximum temperature of 500oC, 0,5 L/min nitrogen flow, 10 minutes holding time and heating rate of 5oC/min was used in the experiment. pH, density, and color improvement were observed.

GC-MS results showed that lower oxygenated compounds in the bio-oil are associated with higher plastic feed composition. Synergetic effect is happened when plastic ratio is 50%. Composition of 12,5% corn cobs and 87,5% polypropylene plastic is found to produce the highest yield of bio-oil with the lowest oxygenates.