BAB V

KESIMPULAN DAN SARAN

5.1 Kesimpulan

1. Pengaruh katalis dan konsentrasi katalis $CeCl_3$ terhadap *hydrochar* dan karbon aktif dari kulit kakao adalah sebagai berikut:
   a) Katalis $CeCl_3$ dan konsentrasi katalis $CeCl_3$ lebih tinggi akan meningkatkan *yield hydrochar* dari kulit kakao.
   b) Penggunaan katalis sebesar 400 mg akan membuat luas permukaan *hydrochar* berkurang akibat kondensasi berlebih pada kulit kakao.
   c) Penggunaan katalis dibandingkan tanpa katalis tidak berpengaruh secara signifikan terhadap luas permukaan karbon aktif dari kulit kakao.
   d) Pada analisis FTIR untuk *hydrochar*, penggunaan katalis $CeCl_3$ akan menurunkan intensitas C-O akibat pemutusan glikosidik. Kemudian, penambahan katalis sebesar 8 akan meningkatkan intensitas gugus -OH sedikit akibat hidrolisis berlebih dan penambahan sebesar 80 mg akan menurunkan gugus -OH akibat reaksi dehidrasi yang lebih dominan. Namun, penambahan sebesar 400 mg pada kulit kakao akan meningkatkan kembali gugus -OH akibat kandungan lignin yang terlarut menjadi lebih banyak.
   e) Pada analisis XRD, penggunaan katalis $CeCl_3$ menunjukan penurunan nilai La (lebar lapisan aromatik), Lc (tinggi susunan lapisan aromatik), dan peningkatan area *highly disordered* yang menandakan struktur yang semakin tidak teratur atau *defect*.
2. Pengaruh katalis dan konsentrasi katalis $CeCl_3$ terhadap *hydrochar* dan karbon aktif dari kulit salak adalah sebagai berikut:
   a) Katalis $CeCl_3$ dan konsentrasi katalis $CeCl_3$ lebih tinggi akan meningkatkan *yield hydrochar* dari kulit salak.
   b) Penggunaan katalis sebesar 400 mg akan membuat luas permukaan *hydrochar* berkurang akibat kondensasi berlebih pada kulit salak.
   c) Penggunaan katalis atau katalis yang lebih tinggi dibandingkan tanpa katalis akan meningkatkan luas permukaan dan volume pori karbon aktif dari kulit salak.

d) Pada analisis FTIR untuk *hydrochar*, penggunaan katalis $CeCl_3$ akan mengurunkan intensitas C-O akibat pemutusan glikosidik. Kemudian, penambahan katalis sebesar 8 mg akan meningkatkan gugus -OH akibat hidrolisis berlebih. Namun, penambahan sebesar 400 mg akan menurunkan gugus -OH akibat reaksi dehidrasi yang lebih dominan.

e) Pada analisis FTIR untuk karbon aktif, penggunaan katalis $CeCl_3$ akan membuat intensitas gugus -OH setelah proses aktivasi masih tinggi dibandingkan karbon aktif tanpa katalis.

f) Pada analisis XRD, penggunaan katalis $CeCl_3$ sebesar 400 mg akan menurunkan nilai La (lebar lapisan aromatik), Lc (tinggi susunan lapisan aromatik), dan peningkatan area *highly disordered* yang menandakan struktur yang semakin tidak teratur atau *defect*.

g) Pada analisis Raman, penggunaan katalis $CeCl_3$ sebesar 400 mg akan meningkatkan nilai ID1/IG yang menandakan peningkatan *defective structure* pada permukaan karbon aktif.

h) Pada analisis SEM, penggunaan katalis $CeCl_3$ sebesar 400 mg akan membuat pembentukan hydrochar lebih sempurna dibandingkan tanpa katalis. Kemudian, penggunaan katalis $CeCl_3$ sebesar 400 mg akan membuat pori karbon aktif yang terbentuk lebih banyak dibandingkan sampel tanpa katalis. Namun, struktur yang terbentuk lebih tidak teratur dibandingkan tanpa katalis.

5.2 Saran

1. Pada proses karbonisasi hidrotermal perlu dilakukan modifikasi alat yang dapat diatur tekanannya sehingga proses subkritik dapat dicapai dengan jelas.
2. Penggunaan konsentrasi katalis yang lebih besar dapat dilakukan untuk mengetahui efeknya terhadap karakteristik karbon aktif yang terbentuk.
3. Proses karbonisasi hidrotermal dengan variasi temperatur yang lebih rendah seperti 200 °C dapat diteliti lebih lanjut untuk mendapatkan karbon aktif yang sesuai sebagai LIC.
4. Proses analisis lebih lanjut seperti *cyclic voltammetry* dapat dilakukan untuk mengetahui nilai kapasitansinya sehingga performanya dapat dibandingkan dengan karbon aktif komersil atau serupa.

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