BAB V
KESIMPULAN

Perkembangan produksi biodiesel di Indonesia terbilang baik, pemerintah Indonesia menetapkan berbagai peraturan yang mengatur penggunaan biodiesel. Peraturan tersebut akan meningkatkan penggunaan bahan bakar biodiesel, sehingga dapat mengurangi berbagai masalah lingkungan (pengurangan gas CO_2). Peraturan yang dibuat oleh Menteri ESDM No.12 tahun 2015 mengatur penggunaan campuran biodiesel, aturan B20 (20% biodiesel + 80% diesel) pada tahun 2018 telah berhasil di laksanakan dan B30 baru saja disahkan pada tahun 2020. Mengingat cadangan minyak bumi Indonesia yang semakin menipis, peraturan tersebut dapat mengurangi penggunaan minyak bumi. Indonesia menghasilkan biodiesel dengan menggunakan bahan baku minyak kelapa sawit. Daerah utama penghasil minyak kelapa sawit di Indonesia berada di Kalimantan. Indonesia mampu menghasilkan 3,4 juta ton minyak kelapa sawit untuk digunakan sebagai bahan baku biodiesel. Proses yang digunakan untuk mendapatkan biodiesel adalah Transesterifikasi, dimana proses tersebut biasanya menggunakan bantuan katalis homogen.

Berdasarkan hasil review yang telah dilakukan memperlihatkan penggunaan modifikasi katalis heterogen *metal oxide* sebagai bahan baku katalis, modifikasi katalis tersebut menghasilkan hasil yang baik. Secara umum penggunaan katalis heterogen dapat mengurangi permasalahan katalis homogen (katalis yang sering digunakan dalam proses transesterfikasi) seperti penggunaan H_2SO_4 (katalis homogen asam) yang dapat menyebabkan tingginya kandungan sulfur dalam hasil biodiesel, serta penggunaan KOH dan NaOH (katalis homogen basa) yang dapat menyebabkan bertambahnya proses separasi produk dengan katalis, proses penangangan katalis basa dan asam yang telah digunakan, dan dibutuhkannya proses penetralan produk yang akan menambah limbah cair. Berdasarkan hal tersebut penggunaan katalis heterogen dinilai dapat meningkatkan efisiensi proses trans/esterifikasi yang akan dilakukan, karena katalis heterogen memiliki fase padat, sehingga mempermudah proses purifikasi dari biodiesel yang berfase cair. Katalis heterogen juga memiliki kelebihan pada nilai penggunaan kembali katalis, dibandingkan dengan penggunaan katalis homogen. Modifikasi katalis berbahan dasar *metal oxide* dapat terus diteliti untuk mendapatkan hasil yang sesuai dengan diinginkan.

Penggunaan teknologi seperti *ultrasonic irradiation*, pemanasan menggunakan *microwave*, dan teknologi sub/superkritis dapat mempengaruhi proses pembuatan biodiesel menggunakan katalis heterogen dengan mengurangi konsumsi energi, meningkatkan laju reaksi, dan meningkatkan *yield* biodiesel. Teknologi pendukung tersebut dapat mempermudah proses pembuatan biodiesel, tetapi perlu dipikirkan kembali segala parameter yang dapat mempengaruhi proses apabila ingin menggunakan teknologi tersebut pada skala yang lebih besar. Perlu dilakukan pendalaman proses untuk meningkatkan kemungkinan penggunaan katalis heterogen, sehingga dapat menggantikan penggunaan homogen. Penggunaan efek parameter (jenis minyak, jenis katalis, kondisi operasi trans/esterfikasi, dan teknologi pendukung) proses yang sesuai dapat mewujudkan biodiesel yang memiliki nilai jual rendah, berkualitas tinggi, dan mengurangi permasalahan lingkungan yang dihasilkan oleh minyak diesel sendiri.

Hasil *review* yang telah dibuat menjelaskan mengenai efek parameter seperti bahan baku minyak/lemak, jenis katalis yang akan digunakan, bahan baku katalis, serta modifikasi katalis untuk meningkatkan hal yang perlu diperhatikan ketika ingin melakukan proses pembuatan biodiesel. Berdasarkan hasil review berikut penulis melihat pengembangan material dengan modifikasi partikel *hollow* dan komposit *metal oxide* memiliki kelebihan yang lebih dibandingkan jenis modifikasi *metal oxide* yang lainnya. Pengembangan modifikasi kedua partikel tersebut yang bersifat fleksibel dan hasil yang didapatkan sangatlah baik. Dapat disimpulkan perlu adanya penelitian lebih terhadap modifikasi katalis *hollow* dan komposit *metal oxide*, sehingga dihasilkan biodiesel dengan proses yang lebih mudah, waktu yang lebih cepat, biaya proses yang lebih murah, tingkat penggunaan kembali bahan katalis yang baik dan *yield* biodiesel yang memuaskan dengan bantuan teknologi pendukung yang juga terus berkembang. Hal tesebut dapat meningkatkan probabilitas penggunaan katalis heterogen khususnya *hollow* dan komposit *metal oxide* untuk menggantikan penggunaan katalis homogen, dalam proses transesterfikasi di dunia Industri.

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