

Production of adipic acid from mixtures of cyclohexanol-cyclohexanone using polyoxometalate catalysts

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Abstrak

Adipic acid production through catalytic conversion of cyclohexanol-cyclohexanone using polyoxometalate H5[a-BW12O40] and H4[a-SiW12O40] as catalysts was carried out systematically. Polyoxometalates H5[a-BW12O40] and H4[a-SiW12O40] were synthesized using an inorganic synthesis method and were characterized using Fourier transform infrared spectroscopy (FTIR). Adipic acid was formed from conversion of cyclohexanol-cyclohexanone and was characterized by using melting point measurement, identification of functional group using FTIR spectrophotometer, analysis of gas chromatography-mass spectrometry (GC-MS), and ¹H and ¹³C NMR (nuclear magnetic resonance) spectrophotometer. This research investigated the influence of reaction time and temperature on conversion. The results showed that adipic acid was formed successfully with a yield of 68% by using H5[a-BW12O40] as catalyst at the melting point of 150-152 °C after optimization. In contrast, using H4[a-SiW12O40] as catalyst, formation of adipic acid was only 3.7%. Investigation of time and temperature showed 9 h as the optimum reaction time and 90 °C as the optimum temperature for conversion of up to 68% adipic acid. Identification using FTIR, ¹H, and ¹³C NMR showed that the adipic acid from conversion of cyclohexanol-cyclohexanone was in agreement with the standard adipic acid data in the literatures. GC-MS analysis indicated that several by-products were formed in conversion of cyclohexanol-cyclohexanone using H5[a-BW12O40] and H4[a-SiW12O40] as catalysts.

Produksi Asam Adipat dari Campuran Sikloheksanol-Sikloheksanon menggunakan Katalis Senyawa Polioksometalat. Produksi asam adipat melalui reaksi konversi katalitik sikloheksanol-sikloheksanon menggunakan senyawa polioksometalat H5[a-BW12O40] dan H4[a-SiW12O40] sebagai katalis telah dilakukan secara sistematis. Polioksometalat H5[a-BW12O40] dan H4[a-SiW12O40] disintesis menggunakan metoda sintesis anorganik dan dikarakterisasi menggunakan spektroskopi FTIR. Asam adipat yang terbentuk dari hasil konversi sikloheksanol-sikloheksanon dikarakterisasi melalui penentuan titik leleh, analisis gugus fungsional menggunakan spektrofotometer FTIR, analisis GC-MS dan analisis menggunakan spektrometer ¹H dan ¹³C NMR. Pengaruh waktu reaksi dan temperatur reaksi pada proses konversi dipelajari pada penelitian ini. Hasil penelitian menunjukkan bahwa asam adipat berhasil terbentuk dengan rendemen sebesar 68% menggunakan H5[a-BW12O40] sebagai katalis dengan titik leleh sebesar 150-152 °C hasil optimasi. Pada sisi lain, pembentukan asam adipat hanya menghasilkan rendemen 3,7% menggunakan katalis H4[a-SiW12O40]. Pengamatan lebih lanjut melalui optimasi terhadap proses konversi sikloheksanol-sikloheksanon menjadi asam adipat menghasilkan waktu optimum reaksi 9 jam dan temperatur reaksi 90 °C menghasilkan asam adipat dengan rendemen sebesar 68%. Identifikasi menggunakan FTIR, ¹H dan ¹³C NMR menunjukkan bahwa asam adipat hasil konversi dari sikloheksanol-sikloheksanon sesuai dengan asam adipat standar dari kepustakaan. Analisis menggunakan GC-MS mengindikasikan pembentukan beberapa produk samping hasil konversi sikloheksanol-sikloheksanon menggunakan katalis H5[a-BW12O40] dan H4[a-SiW12O40].