

# Sintesis dan studi aplikasi macro-sphere silika gel sebagai adsorben dan penukar ion besi dalam limbah HCl pekat teknis = Synthesis and study of silica gel macro-sphere application as iron adsorbent and ion exchanger in used concentrated HCl of technical grade / Zafella Kathya Galstaun

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## Abstrak

Asam HCl pekat teknis mengandung sejumlah Fe sebagai anion  $[\text{FeCl}_4]^-$  yang seringkali tidak dikehendaki untuk aplikasi di industri. Pada penelitian ini, kadar Fe yang sangat tinggi dalam limbah asam HCl pekat teknis akan dikurangi dengan metode adsorpsi dan penukaran ion menggunakan silika gel macro-sphere. Silika gel macro-sphere berpori disintesis dengan metode sol-gel dengan katalis asam dimana dilakukan variasi waktu perendaman etanol (8, 12, dan 18 jam), variasi lama kalsinasi (4, 5, 6, 7, dan 8 jam), juga impregnasi dengan  $\text{Na}_2\text{S}$ . Water-glass  $\text{Na}_2\text{SiO}_3$  digunakan sebagai prekursor silika, surfaktan Alkil Poliglikosida (APG) digunakan sebagai template pori, dan HCl digunakan sebagai katalis asam. Silika gel macro-sphere berpori dikalsinasi pada suhu  $350^\circ\text{C}$ . Analisis TGA dilakukan untuk menentukan temperatur kalsinasi, sedangkan karakterisasi dengan FT-IR untuk mengetahui gugus-gugus yang terdapat pada silika gel macro-sphere berpori, dan BET untuk menentukan luas permukaan, diameter pori, dan volume porinya. Analisis XRF untuk mengetahui kandungan unsur-unsur dalam silika gel macro-sphere berpori, dan analisis AAS untuk menentukan kadar besi dalam limbah HCl pekat teknis sebelum dan sesudah proses adsorpsi dan penukaran ion. Pada penelitian ini, dengan metode perendaman dalam limbah HCl pekat teknis, kemampuan penukar anion besi dari silika terimpregnasi  $\text{Na}_2\text{S}$  adalah 21,1548 mg/g, dan kemampuan adsorpsi besi dari silika tanpa impregnasi ialah 19,4389 mg/g. Dengan metode kolom, kapasitas penukaran ion dari silika terimpregnasi  $\text{Na}_2\text{S}$  adalah 16,865 mg/g, dan kapasitas adsorpsi silika tanpa impregnasi ialah 6,32 mg/g.

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Used concentrated HCl of technical grade contains iron as anion  $[\text{FeCl}_4]^-$  which is not desired for industrial applications. In this research, high concentration of iron in used concentrated HCl of technical grade is reduced by adsorption and ion exchange methods using macro-sphere silica gel. Porous macro-sphere silica gel was synthesized by sol-gel method with acid catalyst modified by varying the period of immersion time in ethanol (8, 12, and 18 hours), varying the duration of calcination time (4, 5, 6, 7, and 8 hours). Furthermore, the silica gel was impregnated with  $\text{Na}_2\text{S}$  for ion exchange application. Water-glass,  $\text{Na}_2\text{SiO}_3$ , was used as the precursor of silica, Alkyl Polyglucoside (APG) non-ionic surfactant serves as porous template, and HCl was used as acid catalyst. The synthesis of porous macro-sphere silica gel involves calcination at temperature of  $350^\circ\text{C}$ . TGA analysis was used to determine calcination temperature, while FT-IR analysis was used to identify the chemical bond functional groups of porous macro-sphere silica gel. BET analysis was used to determine the surface area, pore size, and pore volume of the silica gel, and XRF analysis was used to obtain the elements contained in it. AAS analysis was used to identify the content concentration of iron in the synthesized macro-sphere silica gel, and in the used concentrated HCl of technical grade, before and after the adsorption and ion exchange processes. In this research, with immersion method in used concentrated HCl of technical grade, the capacity of silica macro-sphere as an

ion exchanger is 21,1548 mg/g, and the capacity of silica macro-sphere as an adsorbent is 19,4389 mg/g. With column method, the capacity of silica macro-sphere as an ion exchanger is 16,865 mg/g, and the capacity of silica macro-sphere as an adsorbent is 6,32 mg/g.