Pengaruh Daya, Konsentrasi Awal Limbah, dan Elektroda terhadap Degradasi Limbah Fenol dengan Metode Elektrolisis Plasma Udara = The Effect of Power, Initial Waste Concentration, and Electrodes on the Degradation of Phenol Waste using the Air Plasma Electrolysis Method

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Abstrak

Limbah fenol seringkali mencemari air dan tanah, mengakibatkan pencemaran yang merugikan bagi ekosistem serta menyebabkan risiko serius terhadap kesehatan manusia. Metode elektrolisis plasma adalah salah satu cara efektif untuk menanggulangi masalah limbah ini. Penelitian ini bertujuan untuk menganalisis pengaruh variasi daya pada tegangan tetap, konsentrasi awal limbah, dan penggunaan elektroda stainless steel SS-316 terhadap efektivitas proses yang meliputi fenomena pembentukkan plasma, degradasi limbah fenol, dan ketergerusan anoda. Dalam penelitian ini, udara diinjeksikan melalui katoda menggunakan lengkungan yang akan mengarahkan udara langsung ke zona terbentuknya plasma di anoda. Penelitian dilakukan dengan reaktor 1,2 L menggunakan variasi daya 250 W, 300 W, dan 350 W; dan variasi konsentrasi awal limbah 100 ppm, 200 ppm, dan 300 ppm W dengan elektrolit K2SO4 0,02 M. Pada penelitian ini, didapat hasil degradasi yang lebih baik oleh elektroda stainless steel dibandingkan tungsten. Selama 30 menit, SS-316 mampu mendegradasi fenol hingga 99% sedangkan tungsten hanya mencapai 84%. Sementara itu, ketergerusan tungsten jauh lebih besar dibandingkan SS-316. Pada percobaan ini, hasil degradasi tertinggi mencapai 99,9% yang didapat pada kondisi 350 W, konsentrasi limbah fenol 100 ppm, tegangan 550 V, dan dengan penambahan Fe2+ 20 ppm. Pada kondisi optimum ini juga didapatkan penurunan COD sebesar 85,65% dan terdapat produk samping berupa amonia sebesar 5,25 mmol dan nitrat sebesar 0,34 mmol yang terukur pada menit ke-30.

.....Phenolic waste often pollutes the air and soil, resulting in pollution that is detrimental to ecosystems and poses serious risks to human health. The plasma electrolysis method is one effective way to overcome this waste problem. This research aims to determine the effect of power variations at a fixed voltage, initial waste concentration, and the use of SS-316 stainless steel electrodes on the effectiveness of the process which includes plasma formation phenomena, phenol waste degradation, and anode erosion. In this research, air is injected through the cathode using an arch that will direct the air directly to the plasma formation zone at the anode. The research was carried out with a 1.2 L reactor using power variations of 250 W, 300 W, and 350 W; and variations in initial waste concentration of 100 ppm, 200 ppm, and 300 ppm W with 0.02 M K2SO4 electrolyte. In this research, better degradation results were obtained by stainless steel electrodes compared to tungsten. For 30 minutes, SS-316 was able to degrade phenol up to 99% while tungsten only reached 84%. Meanwhile, the abrasiveness of tungsten is much greater than that of SS-316. In this experiment, the highest degradation results reached 99.9% which were obtained under conditions of 350 W, waste phenol concentration of 100 ppm, voltage of 550 V, and with the addition of Fe2+ 20 ppm. Under these optimum conditions, COD was also reduced by 85.65% and there were by-products in the form of ammonia of 5.25 mmol and nitrate of 0.34 mmol as measured at the 30th minute.