

INTISARI

Korosi atmosferik merupakan salah satu penyebab utama penurunan umur pakai baja pada lingkungan industri dan pesisir, termasuk di kawasan PLTU Adipala, Cilacap. Kondisi lingkungan seperti kadar ion klorida yang tinggi serta tingginya waktu basah (*Time of Wetness/ToW*) berperan besar dalam mempercepat proses korosi. Untuk itu, penelitian ini bertujuan mengkaji pengaruh kondisi lingkungan terhadap laju korosi baja karbon, serta mengevaluasi performa pelindung dari tiga jenis lapisan polimer, yaitu alkyd, epoxy, dan polyurethane, dalam menahan serangan korosi di atmosfer PLTU Adipala.

Metode yang digunakan meliputi uji paparan langsung di tiga lokasi berbeda: pesisir pantai, kawasan industri (ESP), dan kawasan normal. Empat jenis spesimen digunakan: kontrol tanpa pelapis, lapisan alkyd, lapisan epoxy, dan lapisan polyurethane. Pengujian dilakukan secara periodik selama 1, 3, 6, dan 9 bulan. Parameter yang diamati meliputi laju korosi (mengacu ASTM G1 dan G50), kondisi visual permukaan, morfologi dan komposisi unsur melalui SEM-EDS, serta data lingkungan berupa kelembapan relatif, *time of wetness* (ToW), kadar ion klorida, suhu, dan kecepatan angin. Analisis data dilakukan dengan menghitung laju korosi rata-rata per lokasi, menginterpretasi citra SEM-EDS, dan mengkorelasikan hasilnya dengan parameter lingkungan.

Hasil menunjukkan spesimen kontrol mengalami kerusakan paling cepat dengan rata-rata laju korosi di bulan pertama sebesar 1.990 mm/tahun. Korosi yang muncul sejak bulan pertama berkembang menjadi pengelupasan material pada bulan ke-9. Spesimen alkyd mampu memperlambat korosi dengan signifikan, meskipun tetap mengalami *blistering* dan retakan di lingkungan agresif. Laju korosi rata-rata tertinggi spesimen alkyd sebesar 0.0079 mm/tahun. Lapisan epoxy menunjukkan ketahanan lebih baik, dengan korosi baru terindikasi pada bulan ke-6 melalui retakan mikro dan *blistering* kecil. Laju korosi rata-rata tertinggi 0.0077 mm/tahun. Polyurethane memiliki performa perlindungan terbaik, dengan permukaan relatif utuh hingga bulan ke-9 dan rata-rata laju korosi tertinggi hanya 0.0022 mm/tahun. Faktor lingkungan seperti kadar klorida tinggi dan TOW panjang terbukti mempercepat proses korosi di seluruh spesimen, terutama di lokasi pantai.

Kata kunci: korosi atmosferik, *time of wetness*, alkyd, epoxy, polyurethane

ABSTRACT

Atmospheric corrosion is one of the main causes of reduced service life of steel in industrial and coastal environments, including the PLTU Adipala power plant in Cilacap. Environmental factors such as high chloride ion concentration and extended time of wetness (ToW) play a significant role in accelerating corrosion. Therefore, this study aims to examine the influence of environmental conditions on the corrosion rate of carbon steel and to evaluate the protective performance of three types of polymer coatings (alkyd, epoxy, and polyurethane) against atmospheric corrosion in the PLTU Adipala environment.

The research method involved direct exposure tests at three different locations: the coastal area, the industrial zone (ESP), and a normal zone. Four types of specimens were used: uncoated control, alkyd-coated, epoxy-coated, and polyurethane-coated steel. The specimens were exposed for 1, 3, 6, and 9 months. The observed parameters included corrosion rate (based on ASTM G1 and G50), surface visual condition, morphology and elemental composition using SEM-EDS, and environmental data such as relative humidity, time of wetness (ToW), chloride ion concentration, temperature, and wind speed. Data analysis was conducted by calculating the average corrosion rate per location, interpreting SEM-EDS images, and correlating the results with environmental parameters.

The results showed that the control specimen deteriorated most rapidly, with an average corrosion rate of 1.990 mm/year in the first month. Corrosion initiated as early rust spots and developed into severe material peeling by the ninth month. The alkyd coating was able to significantly slow down corrosion, although blistering and cracking occurred in aggressive environments, with a maximum corrosion rate of 0.0079 mm/year. The epoxy coating demonstrated better resistance, with corrosion only observed after six months in the form of microcracks and small blisters, reaching a maximum corrosion rate of 0.0077 mm/year. Polyurethane exhibited the best protective performance, maintaining a relatively intact surface up to nine months, with the highest corrosion rate recorded at only 0.0022 mm/year. Environmental factors such as elevated chloride ion concentration and prolonged ToW were confirmed to accelerate corrosion in all specimens, particularly in the coastal location.

Keywords: atmospheric corrosion, time of wetness, alkyd, epoxy, polyurethane, SEM-EDS