Perilaku korosi glass fiber reinforced unsaturated polyester resin jenis isophthalic dalam larutan basa

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Abstrak

Unsaturated Polyester Resin (UPR) mempunyai sifat elektrik, kimia, dan mekanik yang baik. UPR dapat dipakai dalam beberapa aplikasi dan digunakan untuk berbagai peralatan, misalnya pipa air, kontainer, tangki penyimpanan, gedung, komponen otomotif, dan lambung kapal. Perilaku Korosi Glass Fiber-Reinforced Plastic (GRP) UPR dalam lingkungan basa, khususnya KOH dan NaOH, perlu diselidiki. UPR yang digunakan adalah Yukalac 150 HRBQTN jenis isophthalatic (UPR-iso). Untuk mengetahui perilaku GRP (UPR-iso) tersebut, spesimen direndam dalam larutan KOH dan NaOH.

Penentuan ketahanan korosi GRP (UPR-iso) mengacu pada ASTM C 581-94. Dalam penelitian, diamati perubahan hardness, ketebalan, berat, dan retensi Flexural Strength dan retensi Flexural Modulus. Selain itu juga analisis dengan uji FTIR, SEM-EDX.

Dalam penelitian diperlukan pembuatan GRP(UPR-iso), dimana fiberglass yang digunakan adalah E-glass sebanyak 2 lapis dan C-glass sebanyak 2 lapis. Setelah itu laminat tersebut dipotong menjadi spesimen_ Pada tepi samping spesimen dilapisi vinyl ester Spesimen tersebut direndam dalam larutan 10%, 25%, 50% berat KOH dan NaOH pada suhu 50°C. Spesimen direndam dalam tabung reaksi dan dipanaskan pada waterbath. Interval waktu yang digunakan adalah 1, 2, 3, 6, 18, 29, 39 hail.

Hasil penelitian menunjukkan bahwa seat mekanik (hardness, flexural strength, flexural modulus) GRP(UPR-iso) menurun dan sifat fisik (tebal dan berat) meningkat terhadap waktu. Pada lingkungan KOH, semakin besar konsentrasi penurunan sifat mekanik dan penambahan sifat fisik semakin besar. Sedangkan dalam lingkungan NaOH, pads konsentrasi 25%, penurunan seat mekanik dan penambahan seat fisik, lebih tinggi dibandingkan 10% dan 50%. Semakin lama waktu perendaman dan semakin besar konsentrasi, degradasi fisik dan kimia lebih cepat. Pengecualian pada 50% NaOH, mobilitasnya sudah mulai menurun dibandingkan 25% dan 10%, sehingga proses degradasi lambat dan sedikit.

Perbandingan antara penyerangan KOH dan NaOH terhadap GRP(UPR-iso) adalah lebih tinggi NaOH pada konsentrasi 10% dan 25%, sedangkan pada konsentrasi 50% lebih tinggi KOH. Hal ini dikarenakan BM Na<K, sehingga molaritas Na>K. Semakin besar konsentrasi, pendegradasian semakin cepat. Pengecualian pada 50% NaOH, mobilitasnya sudah menurun jika dibandingkan 50% KOH.

Pada GRP(UPR-iso) terjadi perubahan warna dari merah muda ke kuning/coklat, dan tidak transparan. Pada spesimen yang telah direndam terbentuk lapisan terkorosi pada bagian permukaan (corroded layer forming).

Mekanisme terjadinya korosi pada GRP(UPR-iso) dalam larutan basa adalah degradasi fisik dan degradasi

kimia. Degradasi fisik adalah proses absorbsVdifusi larutan basa ke dalam GRP(UPR-iso) dan terjadinya proses osmosis dalam void. Sedangkan degradasi kimia adalah terjadinya berkurang atau hilangnya gugus ester karena reaksi hidrolisis oleh basa menjadi anion karboksilat dan alkohol.
<hr>Unsaturated polyester resin (UPR) has good electrical, chemical and mechanical properties. UPR can be used in various applications and equipments, such as water pipes, containers, storage tanks, buildings, automotive components, and ship hulls. The corrosion behavior of glass-fiber reinforced plastic (GRP) UPR in alkaline environment, especially KOH and NaOH, will be observed. The UPR used is Yukalac 150 HRBQTN, an isophthalatic UPR_ The specimens will be submerged in KOH and NaOH solutions to find out about GRP (UPR-iso) corrosion behavior.

ASTM C 581-94 is used to determine the GRP (UPR-iso) corrosion resistance. The observed parameters are changes in hardness, thickness, weight, flexural strength retention, and flexural modulus retention. Additional analysis is done with FTIR, SEM-EDX tests.

The GRP (UPR-iso) is created by using 2 layers of E-glass and 2 layers of C-glass, cut into specimens and coated with vinyl ester. The specimens are then submerged in test tubes filled with 10%, 25% and 50% weight KOH and NaOH solutions. The test tubes and the specimens are continuously heated at 50°C using water bath. The observed time intervals are 1, 2, 3, 6, 18, 29 and 39 days.

The results showed that GRP (UPR-iso) mechanical properties (hardness, flexural strength, flexural modulus) weakened the longer it stays in the alkaline solutions while its thickness and weight increased. In KOH solutions, higher concentrations lead to larger weakening of mechanical properties and larger increase in thickness and weight. In NaOH solutions however, it was the 25% solution and not the 50% solution, that exhibited the biggest weakening of mechanical properties and highest increase in thickness and weight. Overall, increasing concentrations and increasing time spent submerged will accelerate the physical and chemical degradation of GRP (UPR-iso). The exception is 50% NaOH solution. At this concentration, the solution's mobility decreased compared to 25% and 10% solutions which slows down the degradation.

When comparing degradations in KOH and NaOH solutions with similar concentration, NaOH caused more degradation at 10% and 25% solutions, white KOH caused more degradations at 50% solution. This is due to Sodium having higher molecular weight than Potassium, thus making Sodium's molarity bigger than Potassium's. Larger alkaline concentrations caused faster degradations with the exception of 50% NaOH solution because of the drop in mobility compared with 50% KOH solution.

Another observed difference is the color change from translucent pink to yellow/brownish. The submerged specimens have corroded layer forming on the surface.

The corrosion mechanism of GRP (UPR-iso) in alkaline solution is by physical and chemical degradation. Physical degradation is the process of absorption/diffusion of alkaline solution into GRP (UPR-iso) and the occurrence of osmosis in the void. While chemical degradation is the decrease or loss of esters because of hydrolysis by alkaline into alcohols and carboxylate anions.