

ABSTRAK

PENGARUH VARIASI KONSENTRASI INHIBITOR TANIN PADA MEDIA PENDINGIN PROSES *QUENCHING* TERHADAP LAJU KOROSI, NILAI KEKERASAN, KEKUATAN TARIK, DAN STRUKTUR MIKRO *STAINLESS STEEL* 316L PADA LINGKUNGAN *GEOTHERMAL* BUATAN

Oleh
Muhammad Alfin
NIM: 116210025
(Program Studi Sarjana Teknik Metalurgi)

Penggunaan material *stainless steel* 316L pada sistem perpipaan *geothermal* rentan mengalami degradasi akibat kondisi operasi ekstrem dan fluida korosif. Upaya peningkatan ketahanan material dapat dilakukan melalui modifikasi struktur mikro dengan perlakuan panas *quenching* serta pemanfaatan inhibitor organik ramah lingkungan seperti tanin. Penelitian ini bertujuan untuk menganalisis pengaruh variasi konsentrasi inhibitor tanin sebagai media pendingin *quenching* terhadap sifat mekanis dan korosi baja *stainless steel* 316L. Metode eksperimental dilakukan dengan memanaskan spesimen pada temperatur 850°C selama 15 menit, lalu didinginkan secara cepat (*quenching*) menggunakan pelarut aquades dengan variasi konsentrasi inhibitor tanin 8%, 10%, dan 12% (w/v). Evaluasi karakteristik material mencakup uji tarik (ASTM E8), uji kekerasan *Rockwell B* (ASTM E18-22), pengamatan mikrostruktur (ASTM E407), serta uji laju korosi metode kehilangan berat (ASTM G31-22) dalam larutan garam buatan bersuhu 100°C selama 24 jam. Hasil pengujian menunjukkan bahwa konsentrasi 10% memberikan peningkatan sifat mekanik paling optimal, dengan nilai *Ultimate Tensile Strength* 598,01 MPa, elongasi 40,65%, dan kekerasan 93,00 HRB. Pengamatan mikrostruktur memperlihatkan fasa tetap didominasi austenit, disertai pembentukan lapisan film yang mencapai ketebalan maksimal 2,22 µm pada konsentrasi 12%. Ketebalan film ini berbanding lurus dengan efektivitas inhibisi, di mana konsentrasi 12% paling optimal menekan laju korosi hingga 0,84 mpy. Kesimpulannya, pendingin dengan konsentrasi tanin 10% paling ideal untuk meningkatkan kekuatan dan kekerasan, sedangkan konsentrasi 12% memberikan perlindungan paling baik terhadap korosi.

Kata kunci: *Stainless Steel* 316L, *Quenching*, Inhibitor Tanin, Korosi, Sifat Mekanis

ABSTRACT

EFFECT OF TANNIN INHIBITOR CONCENTRATION VARIATION IN QUENCHING MEDIA ON THE CORROSION RATE, HARDNESS, TENSILE STRENGTH, AND MICROSTRUCTURE OF 316L STAINLESS STEEL IN A ARTIFICIAL GEOTHERMAL ENVIRONMENT

By

Muhammad Alfin

NIM: 116210025

(Undergraduate Program in Metallurgical Engineering)

The use of 316L stainless steel in geothermal piping systems is susceptible to degradation due to extreme operating conditions and corrosive fluids. Efforts to improve material resistance can be achieved through microstructural modification using quenching heat treatment and the utilization of eco-friendly organic inhibitors such as tannin. This study aims to analyze the effect of variations in tannin inhibitor concentration as a quenching cooling medium on the tensile strength, hardness, microstructure, and corrosion rate of 316L stainless steel. The experimental method was conducted by heating the specimens at a temperature of 850°C for 15 minutes, followed by rapid cooling (quenching) using a distilled water solvent with variations in tannin inhibitor concentrations of 8%, 10%, and 12% (w/v). Evaluation of material characteristics included tensile testing (ASTM E8), Rockwell B hardness testing (ASTM E18-22), microstructural observation (ASTM E407), and corrosion rate testing using the weight loss method (ASTM G31-22) in an artificial salt solution at 100°C for 24 hours. The test results showed that the 10% concentration provided the most optimal improvement in mechanical properties, with an Ultimate Tensile Strength value of 598.01 MPa, an elongation of 40.65%, and a hardness of 93.00 HRB. Microstructural observations revealed that the phase remained dominated by austenite, accompanied by the formation of a film layer that reached a maximum thickness of 2.22 μm at the 12% concentration. This film thickness is directly proportional to the inhibition effectiveness, where the 12% concentration optimally suppressed the corrosion rate down to 0.84 mpy. In conclusion, the cooling medium with a 10% tannin concentration is the most ideal for improving strength and hardness, while the 12% concentration provides the best protection against corrosion.

Keywords: Stainless Steel 316L, Quenching, Tannin Inhibitor, Corrosion, Mechanical Properties