# Penentuan Tegangan Sisa Plat Baja Tahan Karat 304 Canai Dingin dengan Teknik Difraksi dan Analisis Rietveld

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Abstrak

Telah dilakukan pengukuran tegangan sisa dengan teknik difraksi sinar-X, pada lembaran baja tahan karat 304 canai-dingin, yang dideformasi 0, 34, 84, 152, 158, 175 dan 196% reduksi ketebalan. Data difraksi dianalisa menggunakan metode penghalusan struktur Rietveld. Hasil analisa memperlihatkan, partikel martensit mengalami tegangan kompresi dan matriks austenit mengalami tegangan tensil. Baik dalam martensit dan austenit, diatas deformasi 34 % (kandungan martensite meningkat diatas 1 % ), regangan kisi rata-rata adalah anisotropis dan berkurang hampir mendekati kuadratis dengan bertambahnya % reduksi. Kejadian ini secara kualitatif dapat dimengerti dengan mempertimbangkan mismatch ekspansi termal antara butiran martensit dan austenit. Untuk semua spesimen baja tahan karat canai-dingin, puncak difraksi teramati Iebih Iebar dibanding dengan spesimen yang tidak di rol, yang mengindikasikan bahwa regangan dalam bahan inhomogeneous. Dari analisa parameter bentuk puncak, regangan akar kuadrat rata-rata (root means square; rms), yang menggambarkan distribusi medan regangan inhomogeneous dapat diperoleh. Tegangan sisa rata-rata dalam bahan plat baja tahan karat 304 rol-dinngin, menampakkan efek kombinasi dari tegangan hidrostatis antara partikel martensit dan matriks austenit. Tegangan sisa rata-rata dapat dievaluasi dari prediksi regangan kisi rata-rata eksperimental dalam setiap fasa. Hasil mencapai maksimum pada pencanaian 34 % ( 442 MPa) dan minimum pada pencanaian 196% (hampir saling meniadakan) dan sangat bersesuaian dengan pengukuran sifat-sifat mekanik dan pengamatan struktur mikro yang juga didiskusikan. Modulus elastisitas di batas proporsional bervariasi dari 187 GPa hingga sekitar 215 GPa, dan tidak dipengaruhi tegangan sisa.

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A study has been performed to determine the residual stresses using X-ray powder diffraction in a series of cold-rolled stainless steel 304 plates, deforming 0, 34, 84, 152, 158, 175 and 196% reduction in thickness. The diffraction data were analyzed using the Rietveld structure refinement method. The analysis shows that for all specimens, the martensite particles are in compression and the austenite matrix is in tension. For both the martensite and austenite, the average lattice strains are anisotropic and decrease approximately quadratically with an increase in the percent reduction above 34 % (as the martensite phase content increases above 1 %). It is shown that this feature can be qualitatively understood by taking into consideration the thermal expansion mismatch between the martensite and austenite grains. Also, for all cold-rolled stainless steel specimens, the diffraction peaks are broader than the unrolled one, indicating that the strains in these specimens are inhomogeneous. From an analysis of the refined peak shape parameters, the average rootmean square strain, which describes the distribution of the inhomogeneous strain field, was calculated. Finally, the average residual stresses in cold-rolled stainless steel 304 plates were shown to be a combination effect of hydrostatic stresses of the martensite particles and the austenite matrix. The average residual stresses were evaluated from the experimentally determined average lattice strains in each phase. The result is in good agreement with the measurement of mechanical properties and the observation of

surface microstructures, which are also discussed.