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Modelling of creep in a thick-walled cylindrical vessel subjected to internal pressure

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The present study focused on carrying out the creep analysis in an isotropic thick-walled composite cylindrical pressure vessel composed of aluminium matrix reinforced with silicon-carbide in particulate form. The creep behaviour of the composite material has been described by the threshold stress based creep law. The value of stress exponent appearing in the creep law was selected as 3, 5 and 8. The constitutive equations were developed using well known von-Mises yield criteria. Models were developed to find out the distributions of creep stresses and strain rate in thick-walled composite cylindrical pressure vessels under internal pressure. In order to obtain the stress distributions in the cylinder, the equilibrium equation of the continuum mechanics and the constitutive equations are solved together. It was observed that the radial stress, tangential stress and axial stress increases along with the radial distance. The cross-over was also obtained almost at the middle region of cylindrical vessel for tangential and axial stress for different values of stress exponent. The strain rates were also decreasing in nature along the entire radius.

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Effect of anisotropy on steady creep in a whisker reinforced functionally graded composite disk

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In many whisker reinforced composites, anisotropy may result due to material flow during processing operations such as forging, extrusion etc. The consequence of anisotropy, introduced during processing, has been investigated on the steady state creep deformations in a constant thickness rotating disk made of functionally graded 6061Al-SiCw (subscript 'w' stands for whisker). The disk material is assumed to yield according to Hill's anisotropic criterion. The distribution of SiCw reinforcement in the disk is assumed to decrease linearly from the inner to outer radius. The stresses and strain rates in the disk are estimated by solving the force equilibrium equation of the rotating disk along with the constitutive equations describing multi-axial creep. The results obtained for anisotropic functionally graded (FG) disk are compared with those estimated for isotropic FG disk with the same average whisker content. The anisotropic constants, appearing in Hill's yield criterion are obtained from the available experimental results. The results show that the presence of anisotropy reduces the tangential stress in the middle of the disk, but near the inner and outer radii the tangential stress is higher than the isotropic disk. The steady state creep rates in the anisotropic disk are significantly lower than the isotropic disk, with the maximum difference observed at the inner radius. In the presence of anisotropy, the distribution of strain rates becomes relatively uniform over the entire disk, which may reduce the chances of distortion in the disk.

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