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Effect of Anisotropy on Steady Creep in a Whisker Reinforced Functionally Graded Composite Disc

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Abstract : 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 of disc material, has been investigated on the steady state creep deformations of the rotating disc. The disc material is assumed to undergo plastic deformations according to Hill's anisotropic criterion. Steady state creep has been analyzed in a constant thickness rotating disc made of functionally graded 6061Al-SiCw (where the subscript 'w' stands for whisker) using Hill's The content of reinforcement (SiCw) in the disc is assumed to decrease linearly from the inner to outer radius. The stresses and strain rates in the disc are estimated by solving the force equilibrium equation along with the constitutive equations describing multi-axial creep. The results obtained for anisotropic FGM disc have been compared with those estimated for isotropic FGM disc having the same average whisker content. The anisotropic constants, appearing in Hill's yield criterion, have been obtained from the available experimental results. The results show that the presence of anisotropy reduces the tangential stress in the middle of the disc but near the inner and outer radii the tangential stress is higher when compared to isotropic disc. On the other hand, the steady state creep rates in the anisotropic disc are reduced significantly over the entire disc radius, with the maximum reduction observed at the inner radius. Further, in the presence of anisotropy the distribution of strain rate becomes relatively uniform over the entire disc, which may be responsible for reducing the extent of distortion in the disc.

Keywords : anisotropy, creep, functionally graded composite, rotating disc
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