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MIXED CONVECTION FLOW AT THE LOWER STAGNATION POINT OF A CIRCULAR CYLINDER EMBEDDED IN A POROUS MEDIUM FILLED BY A NANOFLUID CONTAINING GYROTACTIC MICROORGANISMS

(Aliran Olakan Campuran pada Titik Genangan Bawah Silinder Bulat yang Dibenam dalam Medium Berliang dengan Nanobendalir yang Mengandungi Mikroorganisma Gyrotactic)

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ABSTRACT

In this paper, the steady mixed convection boundary layer flow near the lower stagnation point of a horizontal circular cylinder with a constant surface temperature embedded in a porous medium saturated by a nanofluid containing gyrotactic microorganisms in a stream flowing vertically upwards for both cases of a heated and cooled cylinder, is studied numerically. The resulting system of nonlinear ordinary differential equations is solved numerically using an implicit finite-difference scheme known as the Keller box method. By considering the governing parameters, namely the mixed convection parameter λ, the bioconvection Lewis number *Lb*, the traditional Lewis number *Le*, the bioconvection Péclet number *Pb*, the buoyancy ratio *Nr*, the bioconvection Rayleigh number *Rb*, the Brownian motion *Nb* and the thermophoresis *Nt*, the numerical results are obtained and discussed for the skin friction coefficient, the local Nusselt number, the local Sherwood number, the local density number of the motile microorganisms as well as the velocity, temperature, nanoparticles volume fraction and motile microorganisms density profiles.

Keywords: bioconvection; horizontal circular cylinder; lower stagnation point; mixed convection; nanofluid; porous medium

ABSTRAK

Dalam makalah ini, aliran lapisan sempadan olakan campuran mantap pada titik genangan bawah silinder bulat mengufuk dengan suhu permukaan malar yang dibenam dalam medium berliang yang dipenuhi nanobendalir dan mengandungi mikroorganisma gyrotactic, dalam aliran yang mengalir menegak ke atas bagi kedua-dua kes silinder yang dipanaskan dan disejukkan, telah dikaji secara berangka. Sistem persamaan pembezaan biasa tak linear yang terhasil diselesaikan secara berangka menggunakan skema beza terhingga tersirat yang dikenali sebagai kaedah kotak Keller. Dengan mempertimbangkan beberapa parameter menakluk, iaitu parameter olakan campuran λ, nombor Lewis bio-olakan *Lb*, nombor Lewis tradisional *Le*, nombor Péclet bio-olakan *Pb*, nisbah keapungan *Nr*, nombor Rayleigh bio-olakan *Rb*, gerakan Brownan *Nb* dan termoforesis *Nt*, keputusan berangka diperoleh dan dibincangkan bagi pekali geseran kulit, nombor Nusselt setempat, nombor Sherwood setempat, nombor ketumpatan setempat bagi mikroorganisma motil serta profil-profil halaju, suhu, pecahan isi padu nanozarah dan ketumpatan mikroorganisma motil.

Kata kunci: bio-olakan; silinder bulat mengufuk; titik genangan bawah; olakan campuran; nanobendalir; medium berliang

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