frequency with the increase of the Hartmann number Ha, except for the case of Ha=60, where a light reduction of f_{Cr} is obtained.

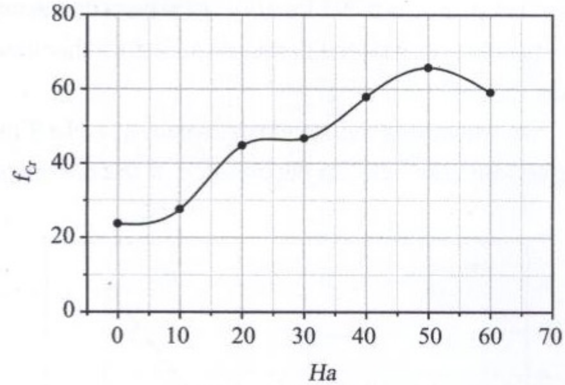

Fig. 11 . Stability diagram ($f_{Cr} - Ha$).

5. Conclusion

A numerical study of the natural convection in a cylindrical enclosure filled with a liquid metal, subjected to an axial temperature gradient and a constant magnetic field, has been carried out. The finite volume method has been used to solve numerically the transport equations. Our numerical simulations have been presented for various values of the Hartmann, in order to see their effects on the value of the critical Grashof number, Gr_{Cr} and of the critical frequency of oscillations, f_{Cr} .In the presence of magnetic field, the fluid continues its stable flow up to the values of Grashof number larger than those foreseeable to have oscillatory instabilities, although the application of magnetic field causes a remarkable change of the flow and heat transfer structures. In conclusion, the results indicate that we can control the flow via the magnetic field.

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Nomenclature

- A aspect ratio = H/r_c
- B_o intensity of magnetic field, Tesla
- f dimensionless frequency
- F Lorentz force, $N.m^{-3}$
- g gravitational acceleration, $m.s^{-2}$
- Gr grashof number = $g\beta(T_H - T_C).r_c^3/\upsilon^2$
- H enclosure height, m
- Ha Hartmann number = $B_0\, r_c \sqrt{\sigma/\rho\upsilon}$
- J electric current density , $A.m^{-2}$
- P dimensionless pressure
- Pr Prandtl number = υ/α
- r,z radial and axial directions,respectively
- R dimensionless radius
- r_c cylindrical radius, m
- Re reynolds number $Re = \Omega.\, r_c^2/\upsilon$
- Ri richardson number = Re/Gr^2
- $\overline{Nu}$ average Nusselt number = $\int_0^1 \frac{\partial\theta}{\partial Z} R\, dR$
- T temperature, K
- U,V dimensionless radial and axial velocities, respectively

Greek symbols

- α thermal diffusivity of the fluid, $m^2.s^{-1}$
- β coefficient of thermal expansion of the fluid, K^{-1}
- θ dimensionaless temperature
- ρ density of the fluid, $kg.m^{-3}$
- σ electric conductivity, $\Omega^{-1}.m^{-1}$
- υ kinematic viscosity of the fluid, $m^2.s^{-1}$
- τ dimensional time
- Ω angular velocity, rad. s^{-1}
- Ψ stream function
- ξ dimensional periodical

Indices

- Cr critical
- C cold
- H hot
- R,Z radial and axial directions, respectively
- 0 reference state

References

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