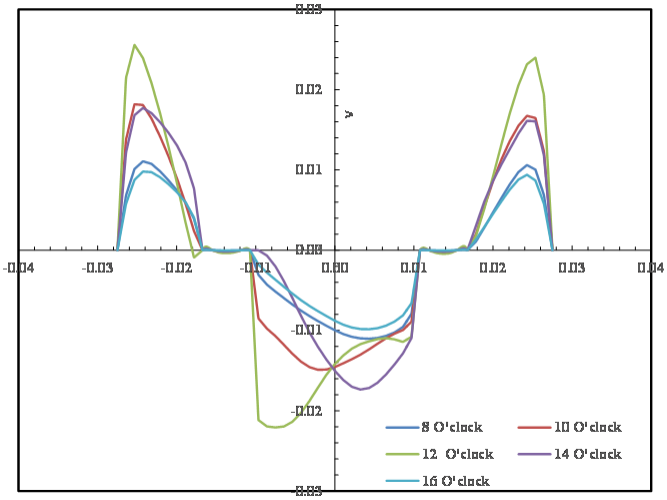

Figure 5. Velocity distribution inside the CPC as a function of tube diameter

5. CONCLUSIONS

This paper tries to analyze the heat transfer process in a modern compound parabolic collector (CPC) equipped with two reciprocating cold and hot tubes using Al_2O_3 as a nano particle in the middle fluid. A three dimensional model is designed based on a real model which is tested successfully. The boundary condition for the collector walls including both top and bottom surfaces are fixed as the heat flux condition equal to q'' and $5q''$, respectively. According to the results, the highest temperature difference value is 3.83 ℃ at 12 O'clock. Also, when the thermal flux is increased gradually, the temperature difference or the water warming rate increases. According to the results the vortex around the cold line is bigger than the vortex around the hot tube. This event is because of the temperature difference between the cold and the hot regions. In other words, the temperature difference between the bottom wall and the cold pipe is higher than the temperature difference between the bottom wall and the hot pipe.

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NOMENCLATURE

Ec	Eckert number, $\mu_f \alpha_f k / \left[(\rho c_p)_f q'' L^3 \right]$
C_P	specific heat at constant pressure
Gr	Grashof number
NU_{lo}	local Nusselt number
NU_{ave}	average Nusselt number
Pr	Prandtl number, ϑ_f / α_f
T	fluid temperature
u,v,w	velocity component in the x-direction and y-direction and z-direction
X,Y,Z	dimensionless space coordinates
U,V,W	dimensionless velocity components in the X-direction and Y-direction and Z-direction
K	thermal conductivity
Ra	Rayleigh Number $\left(= g\beta_f q'' L^4 / k\alpha_f \vartheta_f \right)$

Greek symbols

α	thermal diffusivity
ϑ	kinematic viscosity
$\emptyset$	volume fraction
μ	dynamic viscosity
θ	dimensionless temperature
ρ	fluid density
β	thermal expansion coefficient

Subscripts

c	cold
h	hot
nf	nanofluid
f	base fluid
n	nanoparticle
in	inlet
out	outlet