LEY DE NEWTON DE LA VISCOSIDAD

PARA FLUJOS INCOMPRESIBLES

$$\boldsymbol{\tau} = -\mu\dot{\boldsymbol{\gamma}}$$

Coordenadas Rectangulares

$\tau_{xx} = -2\mu\frac{\partial v_x}{\partial x}$	$\tau_{xy} = \tau_{yx} = -\mu\left(\frac{\partial v_x}{\partial y} + \frac{\partial v_y}{\partial x}\right)$
$\tau_{yy} = -2\mu\frac{\partial v_y}{\partial y}$	$\tau_{xz} = \tau_{zx} = -\mu\left(\frac{\partial v_x}{\partial z} + \frac{\partial v_z}{\partial x}\right)$
$\tau_{zz} = -2\mu\frac{\partial v_z}{\partial z}$	$\tau_{yz} = \tau_{zy} = -\mu\left(\frac{\partial v_y}{\partial z} + \frac{\partial v_z}{\partial y}\right)$

Coordenadas Cilíndricas

$\tau_{rr} = -2\mu\frac{\partial v_r}{\partial r}$	$\tau_{r\theta} = \tau_{\theta r} = -\mu\left(r\frac{\partial}{\partial r}\left(\frac{v_\theta}{r}\right) + \frac{1}{r}\frac{\partial v_r}{\partial \theta}\right)$
$\tau_{\theta\theta} = -2\mu\left(\frac{1}{r}\frac{\partial v_\theta}{\partial \theta} + \frac{v_r}{r}\right)$	$\tau_{rz} = \tau_{zr} = -\mu\left(\frac{\partial v_r}{\partial z} + \frac{\partial v_z}{\partial r}\right)$
$\tau_{zz} = -2\mu\frac{\partial v_z}{\partial z}$	$\tau_{\theta z} = \tau_{z\theta} = -\mu\left(\frac{1}{r}\frac{\partial v_z}{\partial \theta} + \frac{\partial v_\theta}{\partial z}\right)$

Coordenadas Esféricas

$\tau_{rr} = -2\mu\frac{\partial v_r}{\partial r}$	$\tau_{r\theta} = \tau_{\theta r} = -\mu\left(r\frac{\partial}{\partial r}\left(\frac{v_\theta}{r}\right) + \frac{1}{r}\frac{\partial v_r}{\partial \theta}\right)$
$\tau_{\theta\theta} = -2\mu\left(\frac{1}{r}\frac{\partial v_\theta}{\partial \theta} + \frac{v_r}{r}\right)$	$\tau_{r\phi} = \tau_{\phi r} = -\mu\left(r\frac{\partial}{\partial r}\left(\frac{v_\phi}{r}\right) + \frac{1}{r\,\mathrm{sen}\,\theta}\frac{\partial v_r}{\partial \phi}\right)$
$\tau_{\phi\phi} = -2\mu\left(\frac{1}{r\,\mathrm{sen}\,\theta}\frac{\partial v_\phi}{\partial \phi} + \frac{v_r}{r} + \frac{v_\theta \cot\theta}{r}\right)$	$\tau_{\theta\phi} = \tau_{\phi\theta} = -\mu\left(\frac{\mathrm{sen}\,\theta}{r}\frac{\partial}{\partial \theta}\left(\frac{v_\phi}{\mathrm{sen}\,\theta}\right) + \frac{1}{r\,\mathrm{sen}\,\theta}\frac{\partial v_\theta}{\partial \phi}\right)$

NOTACIÓN:

$\boldsymbol{\tau}$ = tensor simétrico del esfuerzo cortante (Pa)

μ = viscosidad (Pa·s = kg/m·s)

$\mathbf{v}$ = vector de velocidad (m/s)

$\dot{\boldsymbol{\gamma}} = \left[(\nabla\mathbf{v}) + (\nabla\mathbf{v})^T\right]$ = tensor simétrico de rapidez de deformación (s^{-1})

$\nabla\mathbf{v}$ = tensor del gradiente de velocidad (s^{-1})

$(\nabla\mathbf{v})^T$ = transpuesta del tensor del gradiente de velocidad (s^{-1})