# STICKY PARTICLES with n-m potential

# Double Venous Valve

# laminar flow

# ---------- Define parameters -------------------------------

variable L equal 0.088 # Length (m)

variable Y equal 0.008 # Height (m)

variable lat equal 0.0001 # particle spacing (m)

variable rho equal 1056.0 # Density (kg/m^3)

variable G equal 0.50 # Gravity (m/s^2 force/mass)

variable F equal 0.008 # push wall (N)

variable T equal 4 #Period of oscillation

variable mu equal 0.0035 # Dynamic viscosity (Pa.s)

variable alpha equal 1

variable Lp equal ${L}/${lat} # particles in x direction

variable Hy equal ${Y}/${lat} # particles in y direction

variable v equal (${G}\*${Y}\*${Y}\*${rho})/(8\*${mu}) # Peak velocity (m/s)

variable Oscil equal -1\*(${F}\*sin(2\*PI\*time/${T})+5000) # Oscillation

variable Oscil2 equal ${F}\*sin(2\*PI\*time/${T})+5000

variable c0 equal 10\*${v} # Sound speed

variable h equal 2.5\*${lat} # Smoothing length

variable skin equal 0.3\*${h}

variable dt equal 0.3\*${c0}/${h} #CFL

variable kwv equal 1e6 # wall/valve

variable kB equal 5e6 # bond valve

variable kwall equal 1e5 # bond wall

variable ka equal 1e-8 # angle

variable kaa equal 1e-8 # angle

variable sgm equal ${lat} # sigma (m)

variable cutf equal ${sgm} # cutoff (m)

variable eps equal 1e-4 # energy epsilon (j)+petit-repuls

variable epsnTip equal 1e-7 #Tip of the valve

variable epsnMid equal 1e-3 #mid of the valve

# ---------- Initialize Simulation ---------------------------

dimension 2

boundary p p p

units si

atom\_style hybrid meso bond angle

bond\_style hybrid harmonic nonlinear

angle\_style harmonic

# ---------- Create simulation box ---------------------------

read\_data mishortdoublecloseopenBondNonlinearTie8.initial

include fullbondcoeffdoublevalveHybrid4.input # nonlinear epsilon r0 lambda

include anglecoeffdoublevalve.input

# ---------- Define Groups ------------------------------

group fluid type 1 8

group membrane type 2

group wall type 3

group squeezedown type 4

group squeezeup type 5

group squeezeup2 type 6

group squeezedown2 type 7

#---------------TRANFORM SOME FLUID IN PARTICLES----------------------

variable fraction equal 0.1 #fraction of particle transformed

set group fluid type/fraction 8 ${fraction} 12393

#----------SOME 'STICKY' VARIABLES------------------------------------

variable sgm8 equal 1.1\*${lat} #

variable cutf8 equal 2.5\*${sgm8} #

variable eps8 equal 1e-5 # energy (the higher the stickier)

#--------------------------------------------------------------------

#region deletefluid block 0.0305 0.0394 -0.000305 0.0003 -0.0005 0.0005

set group all meso/rho ${rho}

# ---------- Calculation laws ---------------------------

# Tait's EOS

pair\_style hybrid/overlay sph/taitwater mie/cut ${cutf} nm/cut ${cutf8}

pair\_coeff \* \* sph/taitwater ${rho} ${c0} ${alpha} ${h}

pair\_coeff 3 3 mie/cut ${eps} ${sgm} 4 2 ${cutf}

#----------THIS PART MAKES PARTICLES STICKY-------------------------

pair\_coeff 8 8 nm/cut ${eps8} ${sgm8} 2 1 ${cutf8}

#-------------------------------------------------------------------

#delete\_atoms region deletefluid

# ---------- Calculation -------------------------

compute rho\_peratom all meso/rho/atom

compute e\_peratom all meso/e/atom

compute ke\_peratom all ke/atom

compute esph all reduce sum c\_e\_peratom

compute ke all ke

variable etot equal c\_ke+c\_esph

# ---------- Initial conditions -------------------------

fix force1 squeezeup addforce 0 0 0

fix force2 squeezedown addforce 0 0 0

fix force3 squeezeup2 addforce 0 -${F} 0

fix force4 squeezedown2 addforce 0 ${F} 0

fix gfix fluid gravity ${G} vector 1 0 0

fix 1 fluid meso

fix 2 membrane meso

fix 3 wall meso/stationary

fix 4 squeezeup meso

fix 5 squeezedown meso

fix 6 squeezeup2 meso

fix 7 squeezedown2 meso

fix 8 membrane viscous 0.1

fix 9 squeezeup viscous 1

fix 10 squeezedown viscous 1

fix 11 squeezeup2 viscous 1

fix 12 squeezedown2 viscous 1

# ---------- Outputs --------------------------------------

dump dump\_id all custom 500000 dump52nonlinear8.lammpstrj id type xs ys zs vx vy c\_rho\_peratom fx fy

dump\_modify dump\_id first yes

#dump\_modify dump\_id append yes

thermo 100000

thermo\_style custom step time c\_esph v\_etot v\_Oscil

thermo\_modify norm no

restart 1500000 restartdumpelastwalldouble52\_8

# ---------- Calculation ----------------------------------

neighbor ${skin} bin

timestep 1e-7 #${dt}

run 1500000

jump elasticwalldouble\_52b8.lmp