HLWYM HEmails

From: Steve Green [steve.green@swri.org]
Sent: Monday, May 05, 2008 5:43 PM
To: Kaushik Das
Subject: Variable rock conductivity
Attachments: prepin.small_test1

Kaushik,
Try the attached prepin file. This file works in FLOW-3D YMUZ2 (9.0) - at least up to 20 seconds. This is a short section of drift with a single waste package. The rock is separated into two blocks with different conductivities. The only thing that I think is different from when we tried this approach with the 200-m drift is that I placed a grid line at the location of the thermal conductivity change. Othet than that, this file is a good representation of the 200-m shortened to 10 m.

Be sure and check the IFVIS paramters in version 9.2

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Hearing Identifier: HLW_YuccaMountain_Hold_EX
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Subject: Variable rock conductivity
Sent Date: 5/5/2008 5:42:35 PM
Received Date: 5/5/2008 5:43:17 PM
From: Steve Green

Created By: steve.green@swri.org

Recipients:
"Kaushik Das" <kdas@cnwra.swri.edu>
Tracking Status: None

Post Office: div18.swri.edu

Files	**Size**	**Date & Time**
MESSAGE	742	5/5/2008 5:43:17 PM
prepin.small_test1	9142	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
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Test #1 for variable rock wall thermal conductivity
Uses small grid to test the usage of piecewise constant thermal conductivity.
Single waste package.


 $xput
    remark='units are mks',
    itb=0,    remark='no free surface',
    ifvis=-1, remark='LES',
    ifenrg=2, remark='solve energy transport equation using first order',
    ifrho=1,  remark='density as function of fluid fraction and local temperature',
    gz=-9.8,  remark='gravity',
    ipdis=1,  remark='hydrostatic pressure in z direction',
    ihtc=2,   remark='evaluate heat transfer and solve the obstacle conduction equation',
    iwsh=1,
    rmrhoe=1.,   remark='Density diffusion term coefficient',
    rmrho=1.,    remark='Energy diffusion term coefficient',
                 remark='   RMRHO, RMRHOE REQUIRED FOR VAPOR TRANPORT MODEL ',
    iusrd=1,
    twfin=20., remark='finish time (sec)',
    delt=1.e-3,
    sprtdt=1.e-1,
    hpltdt=1.,
    imphtc=0,
 $end

 ifvisc=1,
 igmres=1,


 $limits
 $end

 $props
  remark=' equation of state parameters for air @ 417K (average rock wall temperature from grid.xls',
  remark=' Handbood of tables for Applied Engineering Science, 2nd edition, Table 1-2 (See AirProperties.pdf)',
     cv1=728.7,         remark=' specific heat ',
     rhof=.84638,        remark=' density',
     thc1=0.03484,      remark=' conductivity',
     thexf1=2.432e-03, remark=' thermal expansion coefficient ',
     tstar=417.,        remark=' reference temperature for thermal',
     mu1=2.3543e-05,     remark=' viscosity',
 $end

 $scalar
  remark='Water vapor scalars not used for this problem but need to be defined to use the ',
  remark=' radiation and water transport modules together',
  remark='Scalar 1 is the diffusing/advecting water',
  remark='Scalar 2 (non-diffusing) is for storing the surface phase change flux values',
  remark='Scalar 3 (non-diffusing) is for storing the relative humidity values',
  remark='Scalar 4 (non-diffusing) is for storing the net surface liquid accumulation',
  remark='Scalar 5 (non-diffusing) is for storing the vapor water concentration',
  remark='Scalar 6 (non-diffusing) is for storing the liquid water (mist) concentration',
  remark='Scalar 7 (non-diffusing) is for storing the calculation iterations for the',
  remark='    wall mass flux',
  remark='Scalar 8 (non-diffusing) is for storing the calculation iterations for the',
  remark='    mist pahse change in the fluid interior',
  remark='Scalars 7 and 8 are helpful in tuning the value of vaprlx if necessary',
    nsc=8,
    isclr(1)=3, cmsc(1)=0.26e-04, scltit(1)='Tot.Water', rmsc=0.,
    isclr(2)=0, cmsc(2)=0., scltit(2)='Liq.Flux',
    isclr(3)=0, cmsc(3)=0., scltit(3)='Rel.Hum',
    isclr(4)=0, cmsc(4)=0., scltit(4)='Net.Liq',
    isclr(5)=0, cmsc(5)=0., scltit(5)='Vap.Wat',
    isclr(6)=0, cmsc(6)=0., scltit(6)='Liq.Wat',
    isclr(7)=0, cmsc(7)=0., scltit(7)='Itr.Wall',
    isclr(8)=0, cmsc(8)=0., scltit(8)='Itr.Mesh',
 $end

  $bcdata
```

```
   wl=1,  Remark='Left boundary - wall, constant temp',
   wr=1,  Remark='Right boundary - wall, constant temp (cold wall)',
   wf=1,  Remark='Front boundary - Symmetry',
   wbk=1, Remark='Back boundary - Symmetry',
   wb=1,  Remark='Bottom boundary - Symmetry',
   wt=1,  Remark='Top boundary - Symmetry',
$end
 $mesh
   nxcelt=40,
    px(1)=-2.05, nxcell(1)=1,
    px(2)=-1.55, nxcell(2)=3,
    px(3)=0.0,
    px(4)=5.,
    px(5)=10.,
   nycelt=32,
    py(1)=0.,    nycell(1)=28,
    py(2)=2.75,  nycell(2)=3,
    py(3)=4.30,  nycell(3)=1,
    py(4)=4.80,
   nzcelt=58,
    pz(1)=-4.25, nzcell(1)=1,
    pz(2)=-3.75, nzcell(2)=5,
    pz(3)=-2.03, nzcell(3)=48,
    pz(4)=2.75,  nzcell(4)=3,
    pz(5)=4.30,  nzcell(5)=1,
    pz(6)=4.80,
$end

 $obs
   avrck=-3.1,
   nobs=6,
   tobs(1)=0., tobs(2)=100000.,
   Remark='Obstacle 1 - Drift Wall (1.5m rock), Leftmost Block',
     iob(1)=1, ioh(1)=1,
       rah(1)=4.30,zl(1)=-1.55, zh(1)=5., roty(1)=90.,
     iob(2)=1, ioh(2)=0,
       rah(2)=2.75, zl(2)=0., zh(1)=5., roty(2)=90.,
     kobs(1)=1.8, Remark='From Fedor e-mail 12-9-03',
     rcobs(1)=3.e2,
     twobs(1,1)=340.,
    Remark='Obstacle 2 - Phantom Boundary, Leftmost Block',
     iob(3)=2, ioh(3)=1,
       zh(3)=5.,  roty(3)=90.,
     iob(4)=2, ioh(4)=0,
       rah(4)=4.30, zl(4)=-1.55, zh(4)=5., roty(4)=90.,
     twobs(1,2)=340.,
     kobs(2)=1.8, rcobs(2)=3.e2,   remark=' These must be equal to the neighbor rock',
    Remark='Obstacle 3 - Drift Wall (1.5m rock), Rightmost Block',
     iob(5)=3, ioh(5)=1,
       rah(5)=4.30, zl(5)=5., roty(5)=90.,
     iob(6)=3, ioh(6)=0,
       rah(6)=2.75, zl(6)=5., roty(6)=90.,
     kobs(3)=1.3, Remark='From Fedor e-mail 3-10-08',
     rcobs(3)=3.e2,
     twobs(1,3)=340.,
    Remark='Obstacle 4 - Phantom Boundary, Rightmost Block',
     iob(7)=4, ioh(7)=1,
       zl(7)=5.,  roty(7)=90.,
     iob(8)=4, ioh(8)=0,
       rah(8)=4.30, zl(8)=5., roty(8)=90.,
     twobs(1,4)=340.,
     kobs(4)=1.3, rcobs(4)=3.e2,   remark=' These must be equal to the neighbor rock',
    Remark='Obstacle 5 - Invert',
     iob(9)=5, ioh(9)=1,
       rah(9)=2.75, zl(9)=0., roty(9)=90.,
     iob(10)=5, ioh(10)=0,
       zl(10)=-2.03, Remark='From SK-0154 Rev02 1-28-00',
     kobs(5)=1.300, Remark='From Fedor e-mail 12-9-03',
     rcobs(5)=3.e2,
     twobs(1,5)=340.,
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```
   Remark='Obstacle 6 - Heater 1',
     iob(11)=6, ioh(11)=1,
       rah(11)=.9, zl(11)=-2.8, zh(11)=2.8, roty(11)=90.,
       trnx(11)=5., trnz(11)=-1., Remark='From SK-0154 Rev02 1-28-00',
     twobs(1,6)=395., kobs(6)=10., rcobs(6)=30.e2,
     pobs(1,6)=1139.3, pobs(2,6)=1139.3,
 $end



 $fl
   sclri(1)=0.00,
   sclri(5)=0.00,
   sclri(6)=0.,
   presi=101325.,
 $end
  $bf
 $end
  $temp
    tempi=395.,
 $end
  $motn
 $end
  $grafic
 $end
    jobsf=1,
    jobsbk=2,
 $parts
 $end


TableCurve fits to the rock temperatures.
R. Fedors gave the temps in deg.C
These have to be shifted to deg.K
                       100 yr      500 yr        1000 yr         5000 yr
     rocktemp_a(2)= 77.69767311  76.41547423   71.83087757    55.63291587
     rocktemp_b(2)= 0.062572855  0.013307117    0.011242517    0.032655944
     rocktemp_c(2)= 7.210694233  1.851567139    1.392520081    2.020508392
     rocktemp_d(2)= 1.29E-03    -0.000086004   -0.000069534    2.41E-05
     rocktemp_e(2)= 0.168344581 -0.01078641    -0.00777729     0.00382217
     rocktemp_f(2)= 0            3.49E-07       2.00E-07      -7.04E-08
     rocktemp_g(2)= 0            4.11E-05       2.12E-05      -7.1655E-06
     rocktemp_shift(2)=273.15,

Heater Power from R. Fedors 3-10-08
Time, years 100         500         1000         5000
Heat, W/wp 2278.681229  840.1619513 488.0411886  164.9621135
Heat, W/m   373.5542998 137.7314674  80.00675223  27.04296943
 1/2 powers for FLOW-3D for the individual WP's (Obs 4-13)
        1139.340614      420.0809757  244.0205943   82.48105675
Total for all WP's from 66 to 199 m
       24841.36094       9159.142584   5320.449023   1798.357467


 $usrdat

   remark=' Obstacle Temperature Variation',
    idrftw_stg(2)=-2,
     rocktemp_a(2)= 71.83087757,
     rocktemp_b(2)= 0.011242517,
     rocktemp_c(2)= 1.392520081,
     rocktemp_d(2)=-0.000069534,
     rocktemp_e(2)=-0.00777729,
     rocktemp_f(2)= 2.00E-07,
     rocktemp_g(2)= 2.12E-05,
     rocktemp_shift(2)=273.15,
    idrftw_stg(4)=-4,
     rocktemp_a(4)= 71.83087757,
     rocktemp_b(4)= 0.011242517,
     rocktemp_c(4)= 1.392520081,
```

```
   rocktemp_d(4)=-0.000069534,
   rocktemp_e(4)=-0.00777729,
   rocktemp_f(4)= 2.00E-07,
   rocktemp_g(4)= 2.12E-05,
   rocktemp_shift(4)=273.15,




 istwtf_stg='tw',     remark='Energy for phase change comes from wall',
 isvap_stg = 1,       remark='Define scalar index for water concentration DO NOT CHANGE',
 isliq_stg = 2,       remark='Define scalar index for liquid flux         DO NOT CHANGE',
 isrh_stg = 3,        remark='Define scalar index for rel. hum.           DO NOT CHANGE',
 istlq_stg = 4,       remark='Define scalar index for tot.liq. accum.     DO NOT CHANGE',
 isywv_stg  = 5,      remark='Define scalar index for vapor water         DO NOT CHANGE',
 isywl_stg  = 6,      remark='Define scalar index for liquid water (mist) DO NOT CHANGE',
 hvvap_stg=2300000.,  remark='Heat of vaporization',
 cvvap_stg=1411.,     remark='Water vapor specific heat (const. vol.)',
 cvliq_stg=4186.,     remark='Water liquid specific heat (const. vol.)',
 rvap_stg=461.,       remark='Gas constant for water vapor',
 rgas_stg=289.,       remark='Gas constant for air',
 vaprlx_stg=0.8,      remark='Relaxation factor for phase change iterations',
 rhlim_stg='y',       remark='Limit rel humidity to 100 percent',

$end
 Documentation: general comments, background, expectations, etc.
```