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## APPENDIX

### OpenFOAM CASE SETTINGS

#### Intial and boundary condition files for solved variables

CH<sub>4</sub>

```
/*-----*- C++ -*-----
-----*\
| ===== |
| |
| \\ / Field | OpenFOAM: The Open Source CFD
Toolbox |
| \\ / Operation | Version: 2.3.0
| |
| \\ / And | Web: www.OpenFOAM.org
| \\ / Manipulation |
| |
\*-----*
-----*/
FoamFile
{
    version 2.0;
    format ascii;
    class volScalarField;
    object CH4;
}
// *****
// *****

dimensions [0 0 0 0 0 0 0];

internalField uniform 0;

boundaryField
{
    wall
    {
        type zeroGradient;
    }

    Outlet
    {
        type zeroGradient;
    }

    Inlet
    {
        type fixedValue;
    }
}
```

```

        value            0;
    }

    "front.*"
    {
        type              empty;
    }

    "back.*"
    {
        type              empty;
    }
}
//
*****
***** //

```

## CO

```

/*-----*- C++ -*-----
-----*\
|=====|
|
| \\      F ield | OpenFOAM: The Open Source CFD
Toolbox  | \\      O peration | Version: 2.0.0
| \\      A nd | Web:      www.OpenFOAM.org
| \\      M anipulation |
|
\*-----*/
-----*/
FoamFile
{
    version      2.0;
    format       ascii;
    class        volScalarField;
    object       CO;
}
// * * * * *
* * * * * //

dimensions      [0 0 0 0 0 0 0];

internalField   uniform 0;

boundaryField
{
    wall

```

```

    {
        type            zeroGradient;
    }

    Outlet
    {
        type            zeroGradient;
    }

    Inlet
    {
        type            fixedValue;
        value           0;
    }

    "front.*"
    {
        type            empty;
    }

    "back.*"
    {
        type            empty;
    }
}
//
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***** // Electronic Theses & Dissertations *****
***** www.lib.mrt.ac.lk *****

```



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## H<sub>2</sub>

```

/*-----*- C++ -*-----
-----*\
| ===== |
| |
| \\ / F i e l d | OpenFOAM: The Open Source CFD
Toolbox |
| \\ / O p e r a t i o n | Version: 2.3.0
| |
| \\ / A n d | Web: www.OpenFOAM.org
| |
| \\ / M a n i p u l a t i o n |
|
\*-----*
-----*/
FoamFile
{
    version      2.0;
    format       ascii;
    class        volScalarField;
    object       H2;
}

```



```

}
// *****
***** //

dimensions      [0 0 0 0 0 0 0];

internalField   uniform 0;

boundaryField
{
    wall
    {
        type          zeroGradient;
    }

    Outlet
    {
        type          zeroGradient;
    }

    Inlet
    {
        type          fixedValue;
        value         0;
    }

    "front.*"
    {
        type          empty;
    }

    "back.*"
    {
        type          empty;
    }
}
//
*****
***** //

```



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## CO<sub>2</sub>

```
/*-----*- C++ -*-----
-----*\
| ===== |
| |
| \\      / F i e l d | OpenFOAM: The Open Source CFD
Toolbox |
| \\      / O p e r a t i o n | Version: 2.3.0
| |
| \\      / A n d | Web: www.OpenFOAM.org
| |
| \\ / M a n i p u l a t i o n |
|
|*-----*-
-----*/
FoamFile
{
    version      2.0;
    format       ascii;
    class        volScalarField;
    object       CO2;
}
// * * * * *
* * * * * //

dimensions      [0 0 0 0 0 0 0];
internalField   uniform 0.1;

boundaryField
{
    wall
    {
        type      zeroGradient;
    }

    Outlet
    {
        type      zeroGradient;
    }

    Inlet
    {
        type      fixedValue;
        value     0.1;
    }

    "front.*"
    {
        type      empty;
    }
}
```



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```

    "back.*"
    {
        type          empty;
    }
}
//
*****
***** //

```

## H<sub>2</sub>O

```

/*-----*- C++ -*-----
-----*\
| ===== |
| \\      / F ield      | OpenFOAM: The Open Source CFD
Toolbox    |
| \\      / O peration  | Version:  2.3.0
| \\      / A nd        | Web:      www.OpenFOAM.org
|  \\/      M anipulation |
|
\*-----
-----*/
FoamFile
{
    version      2.0;
    format       ascii;
    class        volScalarField;
    object       H2O;
}
// * * * * *
* * * * * //

```

```

dimensions      [0 0 0 0 0 0 0];

```

```

internalField   uniform 0;

```

```

boundaryField

```

```

{
    wall
    {
        type          zeroGradient;
    }

    Outlet
    {
        type          zeroGradient;
    }
}

```

```

Inlet
{
    type            fixedValue;
    value           0;
}


"front.*"
{
    type            empty;
}

"back.*"
{
    type            empty;
}
}
//
*****
***** //

```

## O<sub>2</sub>

```

/*-----*- C++ -*-----
-----*\
| ===== |
| \\ \ / F i e l d | O p e n F O A M : T h e O p e n S o u r c e C F D
Toolbox(  E l e c t r o n i c T h e s e s & D i s s e r t a t i o n s
| \\ \ / O p e r a t i o n | V e r s i o n : 2.3.0
| \\ \ / A n d | W e b : w w w . O p e n F O A M . o r g
| \\ \ / M a n i p u l a t i o n |
|
\*-----*/
-----*/

```

```

FoamFile
{
    version        2.0;
    format          ascii;
    class           volScalarField;
    object          O2;
}
// * * * * *
// * * * * * //

```

```

dimensions      [0 0 0 0 0 0 0];

internalField   uniform 0.232;

boundaryField
{

```

```

wall
{
    type          zeroGradient;
}

Outlet
{
    type          zeroGradient;
}

Inlet
{
    type          fixedValue;
    value         0.232;
}

"front.*"
{
    type          empty;
}

"back.*"
{
    type          empty;
}
}
//
*****
*****//

```



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N<sub>2</sub>

```

/*-----*- C++ -*-----
-----*\
| ===== |
| | \ \ / F i e l d | OpenFOAM: The Open Source CFD
Toolbox | |
| \ \ / O p e r a t i o n | Version: 2.3.0
| | \ \ / A n d | Web: www.OpenFOAM.org
| | \ \ / M a n i p u l a t i o n |
| |
\*-----*-
-----*/

FoamFile
{
    version      2.0;
    format       ascii;
    class        volScalarField;
    object       N2;
}

```

```

}
// *****
***** //

dimensions      [0 0 0 0 0 0 0];

internalField   uniform 0.7547;

boundaryField
{
    wall
    {
        type          zeroGradient;
    }

    Outlet
    {
        type          zeroGradient;
    }

    Inlet
    {
        type          fixedValue;
        value         0.7547;
    }

    "front.*"
    {
        type          empty;
    }

    "back.*"
    {
        type          empty;
    }
}
//
*****
***** //

```



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## Velocity

```

/*-----*- C++ -*-----
-----*\
| ===== |
| |
| \\      / F i e l d | OpenFOAM: The Open Source CFD
Toolbox |
| \\      / O p e r a t i o n | Version: 2.3.0
| |
| \\      / A n d | Web: www.OpenFOAM.org
| |
| \\/      M a n i p u l a t i o n |
|
\*-----*-
-----*/
FoamFile
{
    version      2.0;
    format       ascii;
    class        volVectorField;
    object       U;
}
// * * * * *
* * * * * //

dimensions      [0 1 -1 0 0 0 0];
internalField   uniform (0 0 0);

boundaryField
{
    wall
    {
        type      fixedValue;
        value      (0 0 0);
    }

    Outlet
    {
        type      inletOutlet;
        inletValue (0 0 0);
    }

    Inlet
    {
        type      fixedValue;
        value      (0 0.028 0);
    }

    "front.*"
    {

```



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```
        type          empty;
    }

    "back.*"
    {
        type          empty;
    }
}

//
*****
***** //
```



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## Solution control file: Control Dict dictionary

```

/*-----*-- C++ -*-----
-----*\
| ===== |
| |
| \\      /   F i e l d      | OpenFOAM: The Open Source CFD
Toolbox   |
| \\      /   O p e r a t i o n  | Version:  2.3.0
|
|   \\ /     A n d          | Web:      www.OpenFOAM.org
|
|   \\ /     M a n i p u l a t i o n   |
|
\*-----*-/
-----*/
FoamFile
{
    version      2.0;
    format       ascii;
    class        dictionary;
    location     "system";
    object       controlDict;
}
// *****
* * * * * //
application    movingGridGasificationFoam;
startFrom      latestTime;

//startTime    0;

stopAt         endTime;

endTime       14400;

deltaT        0.05;

writeControl   timeStep;

writeInterval  2000;

purgeWrite    0;

writeFormat   ascii;

writePrecision 6;

writeCompression off;

timeFormat    general;

```



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```
timePrecision 6;

runTimeModifiable false;

//
*****
***** //
```



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## Physical properties used for numerical solution: Physical properties dictionary

```

/*-----*- C++ -*-----
-----*\
| ===== |
| |
| \\      / F ield      | OpenFOAM: The Open Source CFD
Toolbox   |
| \\      / O peration  | Version: 2.3.0
|
| \\      / A nd        | Web:      www.OpenFOAM.org
|
|  \\/      M anipulation |
|
\*-----*-
-----*/

FoamFile
{
    version      2.0;
    format       ascii;
    class        dictionary;
    location     "constant";
    object       physicalProperties;
}
// * * * * * University of Moratuwa, Sri Lanka. * * * * *
* * * * * // Electronic Theses & Dissertations
* * * * * www.lib.mrt.ac.lk

// Solid properties

Solid_density      rhosolid [ 1 -3 0 0 0 0 0 ] 800;
Wood_density      Wooddensity [ 1 -3 0 0 0 0 0 ] 800;
Char_density      Chardensity [ 1 -3 0 0 0 0 0 ] 360;
Ash_density       Ashdensity [ 1 -3 0 0 0 0 0 ] 800;
Pyrolysis_temperature Tp [ 0 0 0 1 0 0 0 ] 473;
Activation_energy E [ 1 2 -2 0 -1 0 0 ] 110e+3;
Frequency         f [ 0 0 -1 0 0 0 0 ] 1e+8;
Fiber_Saturation_Point Mfsp [ 0 0 0 0 0 0 0 ] 0.1;
Char_Fraction     CF [ 0 0 0 0 0 0 0 ] 0.178;
Volatile_Fraction VF [ 0 0 0 0 0 0 0 ] 0.8216;
Ash_Fraction      AF [ 0 0 0 0 0 0 0 ] 0.0004;
Initial_flame_time Tflame [ 0 0 0 0 0 0 0 ] 1200;
Specific_radiation_area Ar [ 0 -1 0 0 0 0 0 ] 1.5;
CO2fraction       CO2f [0 0 0 0 0 0 0] 0.54;
COfraction        COf [0 0 0 0 0 0 0] 0.4;
CH4fraction       CH4f [0 0 0 0 0 0 0] 0.0525;
H2fraction        H2f [0 0 0 0 0 0 0] 0.0075;
radiation_absorption_coefficient abs [0 -1 0 0 0 0 0] 0.375;
P1_model_Gamma   Gammar [0 1 0 0 0 0 0] 1/3;
steffans_constant steffb [1 0 -3 -4 0 0 0] 5.67e-8;

```

```

// Gas properties

Initial_Gas_density          rhogas [ 1 -3 0 0 0 0 0 ] 1.2;
Universal_gas_constant      R [ 1 2 -2 -1 -1 0 0 ] 8.314;
kH2O                        kH2O [ 0 0 0 -1 0 0 0 ] 0.003965;
kH2                          kH2 [ 0 0 0 -1 0 0 0 ] 0.0146;
kCH4                        kCH4 [ 0 0 0 -1 0 0 0 ] 0.009253;
kCO2                        kCO2 [ 0 0 0 -1 0 0 0 ] 0.008;
kCO                          kCO [ 0 0 0 -1 0 0 0 ] 0.012;
kO2                          kO2 [ 0 0 0 -1 0 0 0 ] 0.011;
kN2                          kN2 [ 0 0 0 -1 0 0 0 ] 0.0133;
MH2O                        MH2O [ 1 0 0 0 -1 0 0 ] 22.213;
MH2                          MH2 [ 1 0 0 0 -1 0 0 ] 3.74
MCH4                        MCH4 [ 1 0 0 0 -1 0 0 ] 20.622;
MCO                          MCO [ 1 0 0 0 -1 0 0 ] 28.5;
MCO2                        MCO2 [ 1 0 0 0 -1 0 0 ] 35;
MO2                          MO2 [ 1 0 0 0 -1 0 0 ] 30.43;
MN2                          MN2 [ 1 0 0 0 -1 0 0 ] 28.5;
sigmaH2O                    sigmaH2O [ 0 1 0 0 0 0 0 ] 3.176;
sigmaH2                      sigmaH2 [ 0 1 0 0 0 0 0 ] 3.269;
sigmaCH4                    sigmaCH4 [ 0 1 0 0 0 0 0 ] 3.7345;
sigmaCO                      sigmaCO [ 0 1 0 0 0 0 0 ] 3.7;
sigmaCO2                    sigmaCO2 [ 0 1 0 0 0 0 0 ] 3.826;
sigmaO2                      sigmaO2 [ 0 1 0 0 0 0 0 ] 3.589;
sigmaN2                      sigmaN2 [ 0 1 0 0 0 0 0 ] 3.755;
a                            a [ 0 0 0 0 0 0 0 ] 1760;
b                            b [ 0 0 0 0 0 0 0 ] 0;
c                            c [ 0 0 0 0 0 0 0 ] 0;
D                            D [ 0 1 0 0 0 0 0 ] 0.02;
Evapouration_Coefficient    Aw [ 0 0 -1 0 0 0 0 ] 5.56e+6;
Evaporation_Activation_energy Ew [ 1 2 -2 0 -1 0 0 ] 8.79e+4;
Ambient_Temperature        Ta [ 0 0 0 1 0 0 0 ] 300;
Relative_Humidity          RH [ 0 0 0 0 0 0 0 ] 0.7;
delta                      delta [ 0 0 0 0 0 0 0 ] 1e-25;
Aco2                       Aco2 [ 0 1 -1 -1 0 0 0 ] 3.42;
Ao2                         Ao2 [ 0 1 -1 -1 0 0 0 ] 0.652;
Hs                          Hs [ 1 -3 -1 1 0 0 0 ] 1;

//
*****
***** //

```



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