

Full Length Research Paper

TRNSYS 16: A veritable solar modelling and programming simulation tool used in the design of a continuous solar powered adsorption refrigeration system

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Project feasibility gave rise to the need for simulation. Simulation of a project leads to reduction in production cost, which ensures the success of the proposed project. Also, it provides initial design data for the experimental project. Thus, the design analysis and variables used for project simulation must be designed properly, revised, tested, and re-tested to guarantee how accurate the experimental design is. Hence, solar adsorption refrigeration system was designed, simulated and constructed using zeolite 4A/13X blend and water. The models were simulated using TRNSYS 16.0 simulation tool. From the result, it was observed that the collector area increases with increase in the system COP from month to month. The highest system COP of 1.53 was obtained in the month of April while the least was 0.4 for July due to frequent rainfall. Also, a much high COP was obtained for dry season while lower COP was gotten for harmattan season.

Key words: TRNSYS, adsorption refrigeration, solar cooling, solar adsorption, adsorbent, solar concentrating collectors.

INTRODUCTION

Due to shortage of power from the national power grid in urban cities and inability to connect some rural areas to the grid (Oyedepo, 2012), refrigeration is achieved in homes and other centres such as health care centre etc.

using alternative sources mostly powered by fossil fuel. The use of energy generated from fossil fuel for refrigeration could lead to depletion of ozone layer and cause climatic change. To address this setback, there is

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need to generate power from non-fossil fuel sources such as solar energy which is one of the most attractive non-fossil energy sources for refrigeration. Absorption cooling systems are otherwise used due to its reliability and low-grade thermal energy (Hassan and Mohamad, 2012). The major advantage of absorption cooling system is the higher coefficient of performance (COP) when compared with other refrigeration cycle. The main challenge is the unnecessary auxiliary energy consumption and other energy losses (Nienborg et al., 2017).

Several studies have been conducted on mass and heat transfer for various science and engineering applications (Daniel et al., 2017). Recently, magneto-hydrodynamic mixed convection heat transfer has received lot of attention (Daniel et al., 2017, 2019). The study involves the use of nano-fluid which has the potential to reduce the thermal resistance for lot of engineering applications such as food processing, drug delivery and cooling of micro-chips. The presence of the nanoparticles in the nanofluid enhances the heat transfer and high cooling rate is expected (Daniel et al., 2019).

Various system control and configurations schemes are being studied for system performance optimization with the aim of increasing energy saving. With the introduction of simulation tools like modelica and TRNSYS, complex system can be studied over a long period of time (Khan et al., 2018) and expensive experimental set up can therefore be minimized. Simulation software, TRNSYS 16.0, is mostly used to initiate real time situation of solar insolation (amount of solar radiation over a specified time) on solar harvesters (process of capturing and storing solar energy). For full control of whole simulation, it is necessary to design carefully the proformas from the scratch. There is need to write a mathematical model for the proformas using programming language like FORTRAN/C++. However, simulation analysis may not replicate the exact operating condition. Therefore, it is important to stimulate the components to predict the trend of the expected results. Over the years, TRNSYS has been used by many for simulating and modeling the dynamic performance of solar cooling system which is difficult to estimate during the planning phase.

In this study, solar adsorption refrigeration system was designed, simulated and constructed using zeolite 4A/13x blend and water, and the model part of the system were simulated using TRNSYS 16.0 simulation tool. The design and creation of the models/components followed a definite path from the design of the CPC, to the adsorbers, valve connections, condenser and the evaporator/cold box. A FORTRAN / C++ programming language was developed and used in the TRNSYS simulating applications in order to complete the design of the models which is the first part of the simulation design. The second part of the simulation involved the creation of new component / proforma's for the various component parts of the refrigeration system using TRNSYS, 2018.

Thus the following methods were used in the creation of models: Types 152, 153, 154, and 156 of the TRNSYS, 2018 applications.

METHODOLOGY

On the creation and programming of the proformas in TRNSYS 16 for the simulation of solar powered adsorption continuous refrigeration system, the following methods were used (TRNSYS, 2007a, b, c);

1. The design of proforma using TRNSYS 16.0 based on mathematical model.
2. Declaration of assignment and variable (derivative input, and output) as shown in Appendix B.
3. Exporting the proforma program using FORTRAN compiler.
4. Proforma programming.
5. Using proforma within the TRNSYS assembly window.

Design consideration

In modelling solar adsorption refrigeration system, the following assumptions were adopted and they cater for the transfer functions (Omisanya et al., 2013).

1. There is uniform pressure inside the adsorber bed.
2. There is no mass transfer in the adsorber during the isosteric stage of pre-heating and cooling.
3. Outer zeolite surface is always assumed to be in adsorption equilibrium.
4. Adsorbent / adsorbate density, thermal conductivity and specific capacity are each constant in the temperature range used.
5. There is a steady state flow.
6. Changes in kinetic and potential energy at input and output are negligible.
7. The adsorption and desorption processes are each isobaric (constant pressure).
8. Porous media properties have a cylindrical symmetry.
9. All phases are continuous in thermal, mechanical and chemical equilibrium.
10. Adsorber bed temperature is uniform (there are no temperature gradient at any given time).
11. The vapour temperature is uniform along the pipe duct.
12. Collector output temperature is in equilibrium with the adsorber bed temperature.

TYPE 152: Compound parabolic concentrator

The thermal performance component model of a CPC collector provides the theoretical framework of a compound parabolic concentrator (CPC). Its nomenclature is as shown in Table 1.

Mathematical description

The compound parabolic concentrating (CPC) collectors consist of absorber tube and concentrating reflector. The parabola focus coincides with the absorber intersection. The CPC collects both diffuse radiation and beam coming from the sun. The CPC profile was modeled according to Umair et al. (2014).

$$Q_{ab} = A_{ap}(FI_{bm}\cos\theta_i\tau_c\tau_{cpc}\alpha_{ab} + I_{diff}\tau_c\tau_{diff}\alpha_{ab}) \quad (1)$$

Table 1. Nomenclature of a TYPE 152 Compound parabolic concentrator.

Symbol	Unit	Description	Variable	Value
Aap	m ²	Area of collector aperture	Parameter	0.25
F	Dimensionless	Indicated whether the radiation incident is effective for the CPC. F = 1 if not, F = 0 otherwise	Input	0 or 1
I _{bm}	W/m ²	Incident beam radiation	Input	Changing
Cosθ _i	Degree	Angle of incidence	Parameter	11.06
T _c	Dimensionless	Transmittance of CPC cover	Parameter	0.89
T _{cpc}	Dimensionless	Transmittance of CPC collector	Parameter	0.88
α _{ab}	Dimensionless	Absorptance of the absorber	Input	0
I _{diff}	Dimensionless	Diffused incident radiation	Input	0
T _{diff}	Dimensionless	Diffused transmittance	Parameter	0.93

Table 2. Nomenclature of TYPE 153 Adsorption and desorption bed.

Symbol	Unit	Description	Variable	Value
A _a	m ²	Area of the absorber	Output	0.113
r _o	m ²	Outer radius of absorber	Input	0.03
L	m	Length of absorber	Input	1.2

TYPE 153: Adsorption and desorption bed

This component models the concentric design of the bed within the absorber pipe it provides for the theoretical analysis of the absorber as shown in Appendix A. For evaluating the thermal performance and mass transfer in the absorber profile, the proforma was modelled according to Umair et al. (2014) and Acuna et al. (2016). Its nomenclature is as shown in Table 2.

Mathematical description

Within the CPC absorber is a concentric layer of pipe in which the adsorption and desorption bed is located. The design provides for the means to charge the bed with zeolite and water. As the temperature of the absorber increases, the heat travels inward to the bed, driving the system to steam up. Vapor produced travels through the annulus of the absorber to the condenser. For the concentricity of the absorber, Acuna et al. (2016) was used to model the beds while the absorber and CPC profile was modelled according to Umair et al. (2014).

$$A_a = 2\pi \times r_o \times L \quad (2)$$

$$Q_{ab} = A_{ap}(F I_{bm} \cos\theta_i \tau_c \tau_{cpc} \alpha_{ab} + I_{diff} \tau_c \tau_{diff} \alpha_{ab}) \quad (3)$$

TYPE 154: Cold box (Evaporator)

The component models the cooling performance of a cold box. It provides the theoretical analysis of an evaporator in respect to changes in temperature and pressure. For evaluating the cooling of the evaporator performance, the cold box profile was modeled based on the equation by Umair et al. (2014) and Ityona (2008). Its nomenclature is as shown in Table 3.

Mathematical description

An evaporator consists of a pipe separated from the condenser by a throttle valve. The constriction by the valve creates a change in the pressure and thus the temperature of the evaporator. This will cause the heat within the cold box to be sucked up, thus leaving the cold volume cooler. The mathematical models by Umair et al. (2014) were used in the simulation to show the total mass of water absorbed in the receiver bed, evaporator energy, specific cooling power, evaporator temperature, coefficient of performance, absorbed mass of water per instance and change in formation of ice.

Performance index:**Total mass of water adsorbed:**

$$M_{total_Absorbed} = m_{zax} \times (dq^d - dq^a) \times 2 \quad (4)$$

Evaporator energy:

$$Q_e = M_{total_Absorbed} \times L_{HW} \quad (5)$$

Evaporator temperature:

$$Q_{ev} = m_{ev} C_{p_{ev}} (T_{ev} - T_{wt}) \quad (6)$$

Specific cooling power:

$$SCP = Q_e / (m_{zax} + m_{zax} + m_{zax} + m_{zax}) \quad (7)$$

Coefficient of performance:

$$COP = \frac{Q_e}{A_{ap} \int_{sunrise}^{end\ of\ desorption} (I_{bm} \cos\theta_i + I_{diff})(t) dt} \quad (8)$$

Table 3. Nomenclature of TYPE 154 Cold box (Evaporator).

Symbol	Unit	Description	Variable	Value
$M_{total_absorbed}$	kg	Total mass of water absorbed	Output	0.24
dq^d	kg	Change in uptake at desorption	Input	0.25
m_{zax}	kg	Mass of Zeolite	Input	0.5
dq^a	kg	Change in uptake at adsorption	Input	0.01
L_{Hw}	J/kg	Latent heat of water	Parameter	2230
m_{ev}	kg	Mass of evaporator	Input	4
Cp_w	kJ/kg K	Specific heat capacity of water	Parameter	4.2
T_{wt}	K	Temperature of water tank	Input	298
T_{ev}	K	Temperature of evaporator	Input	300
Q_{ev}	kJ	Energy of evaporator	Output	Changing
SCP	kJ/kg	Specific cooling power	Output	Changing
dt	Hours	Simulation time	Input	8 - 18
$X\%$	kg	Absorbed mass of water	Output	Changing
dM_{ice}	kg	Change in ice formation	Output	Changing
Kay	Dimensionless	When evaporator temperature = 0 ° or below otherwise it is 0.	Input	Changing
$Symbol_g$	Dimensionless	1 during adsorption otherwise 0.	Input	0 or 1

Table 4. Nomenclature of TYPE 156 Condenser.

Symbol	Unit	Description	Variable	Value
m_c	kg	Mass of condenser	Output	4
Cp_c	J/kg K	Specific heat capacity of the condenser	Input	0.385
T_{co}	K	Outlet temperature of condenser	Input	440.149994
T_{ci}	K	Inlet temperature of condenser	Parameter	400.149994
Q_{cond}	K	Temperature of the condenser	Output	Changing

Absorbed mass of water:

$$X\% = \frac{\text{Absorbed mass of water}}{\text{mass of adsorbent}} \quad (9)$$

Change in ice formation:

$$dM_{ice} = kay * Symbol_g * LHw * Mz * dqa \quad (10)$$

TYPE 156: Condenser

The component models the thermal performance of a condenser. It provides for the theoretical analysis of a heat exchanger. For evaluating the thermal performance of the condenser, the profile of the heat exchange was modeled using equation stated by Umair et al. (2014). Its nomenclature is as shown in Table 4.

Mathematical description

A condenser consists of a pipe connected to the absorber, and wound parallel to each other with fins cutting across the rounds. The fins are to aid in quick exchange of heat as the fluid travels to the evaporator. The mathematical models used for the modeling of

the condenser is that according to TRNSYS Mathematical Reference (2007)

Condenser temperature:

$$Q_{cond} = -mc * Cp_c * (T_{co} - T_{ci}) \quad (11)$$

Based on these models, a studio was developed in TRNSYS to simulate the proposed refrigeration system presented on Figure 1.

RESULTS AND DISCUSSION

Figure 2 presents a comparison of collector area and COP from January to December of a metrological year. The optimized results of the designed continuous solar adsorption refrigeration system, taking into consideration the parametric study of aperture area and system COP is shown as follows in Figure 2.

The chart in Figure 2 from optimization showed that as the collector area increased there was a corresponding increase in the system COP from month to month with

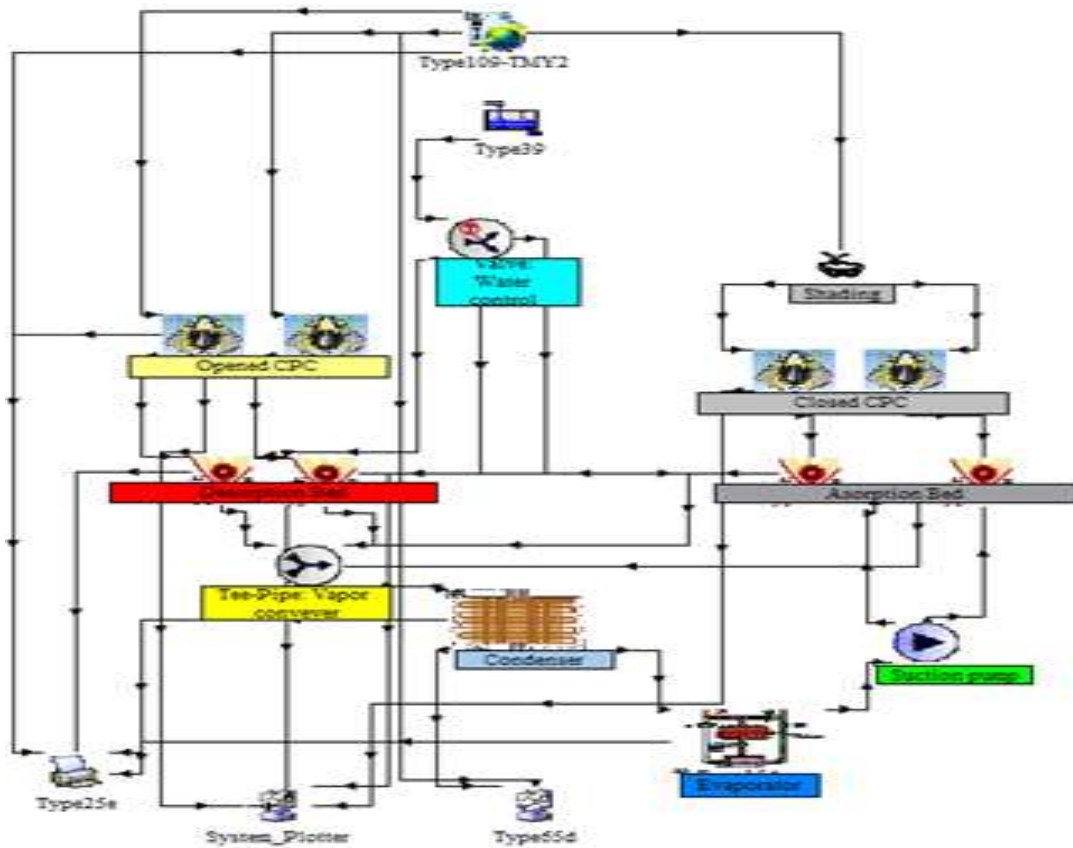


Figure 1. TRNSYS Simulation Studio.

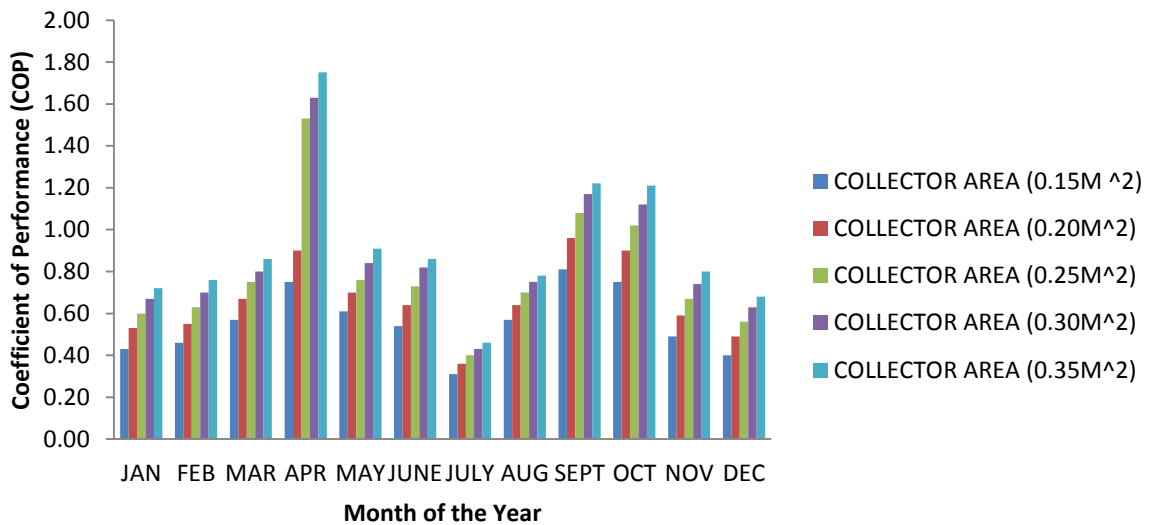


Figure 2. Monthly comparison of collector area and system COP.

the month of April having the highest system COP of 1.53 and the month of July having the least system COP of

0.4. April had the highest system COP as shown in Figure 2 since the month gave the highest solar

insolation in Zaria while July had the lowest system COP given the least insolation due to the fact that the rains is at its peak. It was also observed that during the dry season of February to April there was a corresponding rise in system COP owing to high solar insolation at that time and from November to December. There was a corresponding decrease in system COP due to harmattan season. Also, there was a sudden rise in system COP in the month of September and October after the rains have rescinded; this was expected due to the fact that the two months following the rainy season use to witness high solar insolation before the commencement of harmattan.

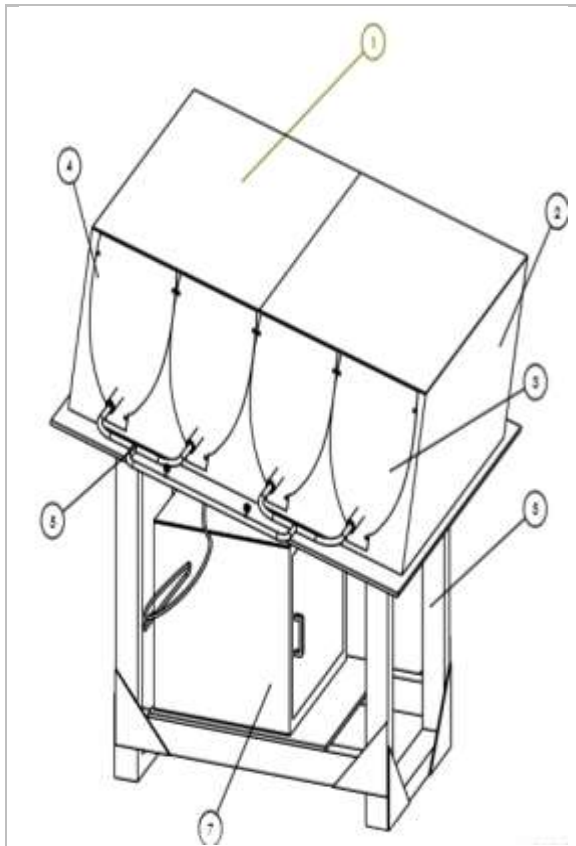
CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

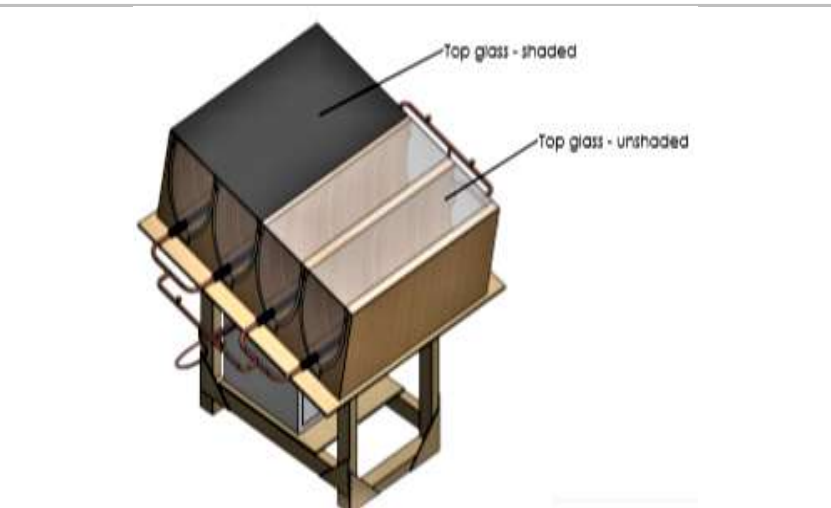
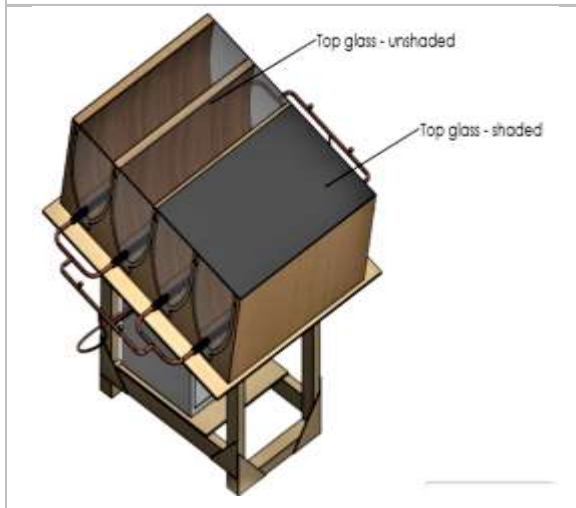
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APPENDIX A: 3D AND ISOMETRIC VIEW OF THE CONTINUOUS SOLAR ADSORPTION REGRIGARATING SYSTEM



Item No.	Part Name	Description	Quantity
1	Top glass	Glass cut to size	2
2	Wooden assembly	Wood cut to shape and size	1
3	Wooden side glass	Glass cut to size to cover the parabolic shape	5
4	Ceiling board covered with reflection film	Ceiling board folded to parabolic shape and covered with reflection film	4
5	Parabolic collector box stand	Wood cut and fabricated to form the stand frame for the solar powered adsorption refrigeration system assembly	1
6	Adsorber copper pipe	Copper pipes fabricated to form the adsorber pipe	4
7	Refrigeration Cabinet Assembly	Refrigeration cabinet assembly houses the cold box, cold box lagged with fibre-glass, cut insert, vacuuming copper pipe and condenser fin pipe	1



APPENDIX B

TRNSYS 16.1 FORTRAN CODE FOR THE CPC MODEL

```

1.      SUBROUTINE TYPE152 (TIME,XIN,OUT,T,DTDT,PAR,INFO,ICNTRL,*)
2.      C*****
3.      C Object: CPC
4.      C Simulation Studio Model: Type152
5.      C
6.      C Author: SowunmiRasheedAdetunji
7.      C Editor:
8.      C Date: November 17, 2017 last modified: November 17, 2017
9.      C *** Model Parameters
10.     C ***
11.     C           Aap    m^2 [-Inf;+Inf]
12.     C           Incidence angle degrees [-Inf;+Inf]
13.     C           TauC   - [-Inf;+Inf]
14.     C           TauCPC - [-Inf;+Inf]
15.     C           Taudiff - [-Inf;+Inf]
16.
17.     C *** Model Inputs
18.     C ***
19.     C           F      - [-Inf;+Inf]
20.     C           lbm    - [-Inf;+Inf]
21.     C           Xab    - [-Inf;+Inf]
22.     C           ldiff  - [-Inf;+Inf]
23.     C           divider - [-Inf;+Inf]
24.
25.     C *** Model Outputs
26.     C ***
27.     C           Qr     K [-Inf;+Inf]
28.     C           Qr2   K [-Inf;+Inf]
29.
30.     C *** Model Derivatives
31.     C ***
32.
33.     C (Comments and routine interface generated by TRNSYS Studio)
34.     C*****
35.
36.     C TRNSYS access functions (allow to access TIME etc.)
37.     USE TrnsysConstants
38.     USE TrnsysFunctions
39.
40.     C-----
41.     INTEGER NITEMS
42.     C-----
43.     C-----
44.     C ADD DECLARATIONS AND DEFINITIONS FOR THE USER-VARIABLES HERE
45.
46.
47.     C PARAMETERS
48.     DOUBLE PRECISION Aap
49.     DOUBLE PRECISION Incidence_angle
50.     DOUBLE PRECISION TauC
51.     DOUBLE PRECISION TauCPC
52.     DOUBLE PRECISION Taudiff

```



```

53. C INPUTS
54.   DOUBLE PRECISION F
55.   DOUBLE PRECISION lbm
56.   DOUBLE PRECISION Xab
57.   DOUBLE PRECISION Idiff
58.   DOUBLE PRECISION divider
59.   double precision ans1
60.   double precision ans2
61.
62. C-----
63. C
64. Aap=PAR(1)
65. Incidence_angle=PAR(2)
66. TauC=PAR(3)
67. TauCPC=PAR(4)
68. Taudiff=PAR(5)
69.
70. C-----
71. C
72.   F=XIN(1)
73.   lbm=XIN(2)
74.   Xab=XIN(3)
75.   Idiff=XIN(4)
76.   divider=XIN(5)
77.   IUNIT=INFO(1)
78.   ITYPE=INFO(2)
79.
80. C-----
81. C SET THE OUTPUTS FROM THIS MODEL IN SEQUENTIAL ORDER AND GET OUT
82.
83.   ans1 = (F*lbm*cos(Incidence_angle)*TauC*TauCPC*Xab)
84.   ans2 = (Idiff*Taudiff*TauCPC*Xab)
85. C      Qr
86.   OUT(1)=Aap*(ans1+ans2)
87. C      Qr2
88.   OUT(2)=Aap*(lbm/divider)
89. C
90. C-----
91. C EVERYTHING IS DONE - RETURN FROM THIS SUBROUTINE AND MOVE ON
92.   RETURN 1
93.   END
94. C-----

```

TRNSYS 16.1 FORTRAN CODE FOR THE ADSORBER BED

```

1.   SUBROUTINE TYPE153 (TIME,XIN,OUT,T,DTDT,PAR,INFO,ICNTRL,*)
2.   C*****
3.   C Object: Bed
4.   C Simulation Studio Model: Type153
5.   C
6.   C Author: AdetunjiRasheedSowunmi
7.   C Editor:
8.   C Date: January 27, 2018 last modified: January 27, 2018
9.   C *** Model Parameters
10.  C ***

```

```

11.
12. C *** Model Inputs
13. C ***
14. C          Ub      W/m^2.K [-Inf;+Inf]
15. C          Ar      m^2 [-Inf;+Inf]
16. C          Tab      K [-Inf;+Inf]
17. C          Tbd      K [-Inf;+Inf]
18. C          Lambda   - [-Inf;+Inf]
19. C          Mz       kg [-Inf;+Inf]
20. C          dqd/dt   kg/s [-Inf;+Inf]
21. C          CPw      J/kg.K [-Inf;+Inf]
22. C          Tcd      K [-Inf;+Inf]
23. C          dqa/dt   kg/s [-Inf;+Inf]
24. C          Tba      K [-Inf;+Inf]
25. C          Te       K [-Inf;+Inf]
26. C          Hst      K [-Inf;+Inf]
27. C *** Model Outputs
28. C ***
29. C          Adsorption bed - [-Inf;+Inf]
30. C          Desorption bed - [-Inf;+Inf]
31.
32. C *** Model Derivatives
33. C ***
34.
35. C (Comments and routine interface generated by TRNSYS Studio)
36. C-----
37. C  SET THE OUTPUTS FROM THIS MODEL IN SEQUENTIAL ORDER AND GET OUT
38. C          ans1 = Lambda*(Hst*Mz*Dqd_dt+Mz*Cpw*(Tbd-Tcd)*Dqd_dt)
39. C          Adsorption bed
40. C          OUT(1)=Ub*Ar*(Tab-Tbd)+ans1
41.
42. C          ans2=Lambda*(Hst*Mz*Dqa_dt+Mz*Cpw*(Tba-Te)*Dqa_dt)
43. C          Desorption bed
44. C          OUT(2)=Ub*Ar*(Tab-Tba)+ans2
45.
46. C-----
47. C  EVERYTHING IS DONE - RETURN FROM THIS SUBROUTINE AND MOVE ON
48. C  RETURN 1
49. C  END
50. C-----

```

TRNSYS 16.1 FORTRAN CODE FOR THE COLD BOX

```

1.      SUBROUTINE TYPE154 (TIME,XIN,OUT,T,DTDT,PAR,INFO,ICNTRL,*)
2.      C*****
3.      C Object: Refrigerator (Cold Box)
4.      C Simulation Studio Model: Type154
5.      C
6.      C Author: AdetunjiRasheedSowunmi
7.      C Editor:
8.      C Date: October 15, 2017 last modified: October 15, 2017
9.      C *** Model Parameters
10.     C ***
11.     C          LHw    J/kg [-Inf;+Inf]
12.

```

```

13. C *** Model Inputs
14. C ***
15. C           Mz      kg [-Inf;+Inf]
16. C           Dqd     kg [-Inf;+Inf]
17. C           Te      K [-Inf;+Inf]
18. C           Twt     K [-Inf;+Inf]
19. C           dqa     kg [-Inf;+Inf]
20. C           Kay     - [-Inf;+Inf]
21. C           Symbol g   - [-Inf;+Inf]
22. C           theta   - [-Inf;+Inf]
23. C           lbm     - [-Inf;+Inf]
24. C           Idiff   - [-Inf;+Inf]
25. C           Aap     m^2 [-Inf;+Inf]
26. C           Mev     kg [-Inf;+Inf]
27. C           CPev    J/kg.K [-Inf;+Inf]
28. C           tl      hr [-Inf;+Inf]
29. C           tu      hr [-Inf;+Inf]
30. C           lbm2    - [-Inf;+Inf]
31. C           theta2  - [-Inf;+Inf]
32. C           Idiff2  - [-Inf;+Inf]
33.
34. C *** Model Outputs
35. C ***
36. C           dMice   - [-Inf;+Inf]
37. C           CoP     - [-Inf;+Inf]
38. C           Scp     kJ [-Inf;+Inf]
39. C           Qe      J [-Inf;+Inf]
40. C           Temperature of Evaporator      K [-Inf;+Inf]
41.
42. C *** Model Derivatives
43. C ***
44.
45. C (Comments and routine interface generated by TRNSYS Studio)
46. C*****
47. C-----
48. C   SET THE OUTPUTS FROM THIS MODEL IN SEQUENTIAL ORDER AND GET OUT
49.
50.           ans1=(lbm*COS(theta)+ldiff)*tl
51.
52.           ans2=(lbm2*COS(theta2)+ldiff2)*tu
53. Mtotal_absorbed = Mz*(dqd-dqa)*2
54.   if (Te> 0) then
55.     kay = 0
56.   else
57.     kay = 1
58.   end if
59. C           dMice
60.           OUT(1)=kay*Symbol_g*LHw*Mz*dqa
61. C           CoP
62.           OUT(2)=(OUT(4)/(Aap*(ans2-ans1)))
63. C           Scp
64.           OUT(3)=(OUT(4)/(Mz+Mz+Mz+Mz))
65. C           Qe
66.           OUT(4)=Mtotal_absorbed*LHw
67.
68. C           Temperature of Evaporator

```

```

69.          OUT(5)=mev*CPEv*(Te - Twt)
70.
71. C-----
72. C  EVERYTHING IS DONE - RETURN FROM THIS SUBROUTINE AND MOVE ON
73.   RETURN 1
74.   END
75. C-----

```

TRNSYS 16.1 FORTRAN CODE FOR THE CONDENSER

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1.      SUBROUTINE TYPE156 (TIME,XIN,OUT,T,DTDT,PAR,INFO,ICNTRL,*)
2.      C***** (TRNSYS,   Programmers   guide,   2007) (TRNSYS,   Programmers   guide,
2007)*****
3.      C Object: Condenser
4.      C Simulation Studio Model: Type156
5.      C
6.      C Author: AdetunjiRasheedSowunmi
7.      C Editor:
8.      C Date: January 27, 2018 last modified: January 27, 2018
9.      C
10.     C
11.     C ***
12.     C *** Model Parameters
13.     C ***
14.
15.     C ***
16.     C *** Model Inputs
17.     C ***
18.     C          mc      kg/hr [-Inf;+Inf]
19.     C          Cp      J/kg.K [-Inf;+Inf]
20.     C          Tci     K [-Inf;+Inf]
21.     C          Tco     K [-Inf;+Inf]
22.
23.     C ***
24.     C *** Model Outputs
25.     C ***
26.     C          Condenser Temperature      K [-Inf;+Inf]
27.
28.     C ***
29.     C *** Model Derivatives
30.     C ***
31.
32.     C (Comments and routine interface generated by TRNSYS Studio)
33.     C-----
34.     C  SET THE OUTPUTS FROM THIS MODEL IN SEQUENTIAL ORDER AND GET OUT
35.
36.     C          Condenser Temperature
37.           OUT(1)=-mc*Cp*(Tco - Tci)
38.
39.     C-----
40.     C  EVERYTHING IS DONE - RETURN FROM THIS SUBROUTINE AND MOVE ON
41.   RETURN 1
42.   END
43.     C-----

```