DME(10 TPD) Process Simulation Using Aspen Plus Release 12.1

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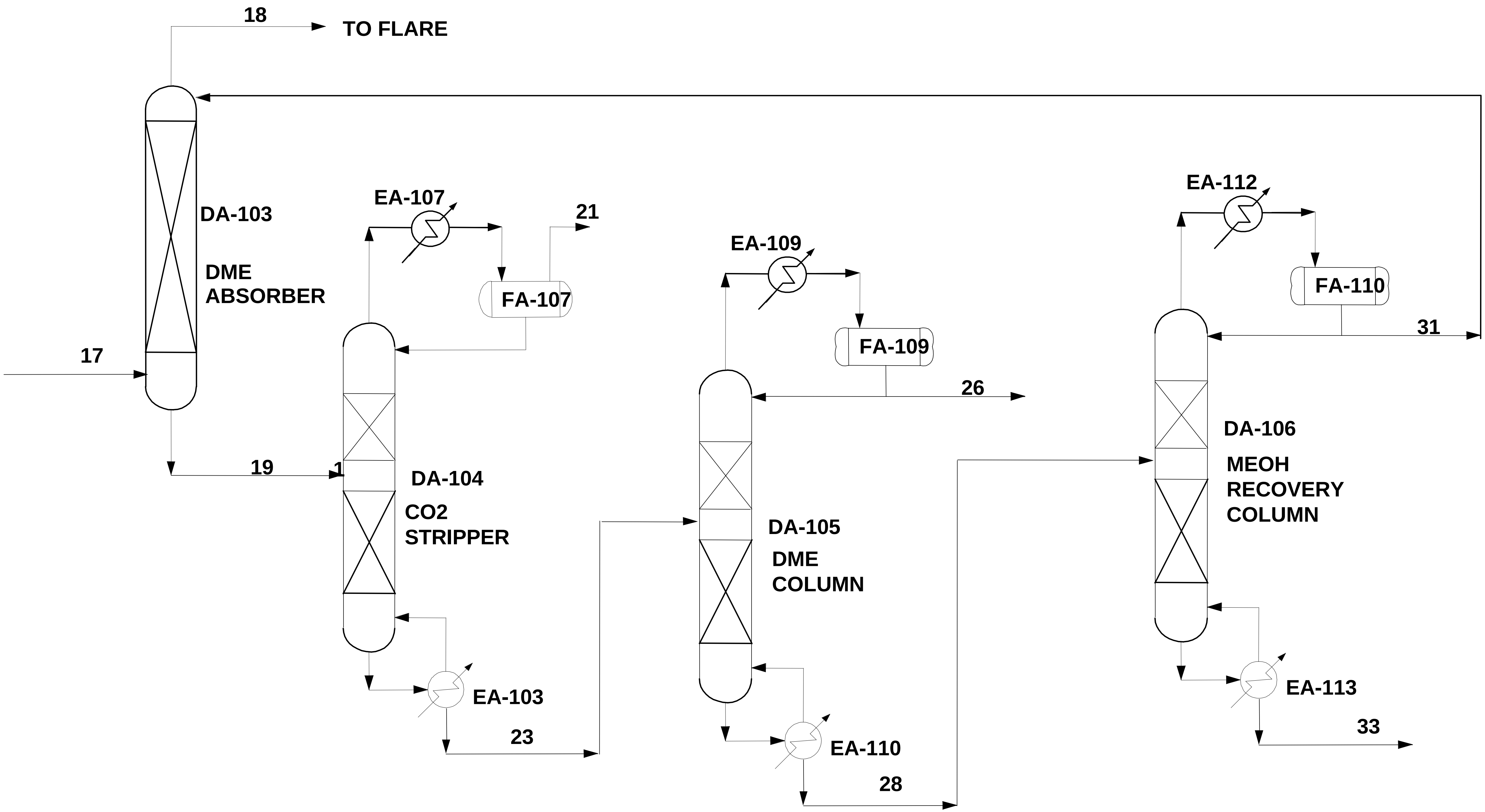
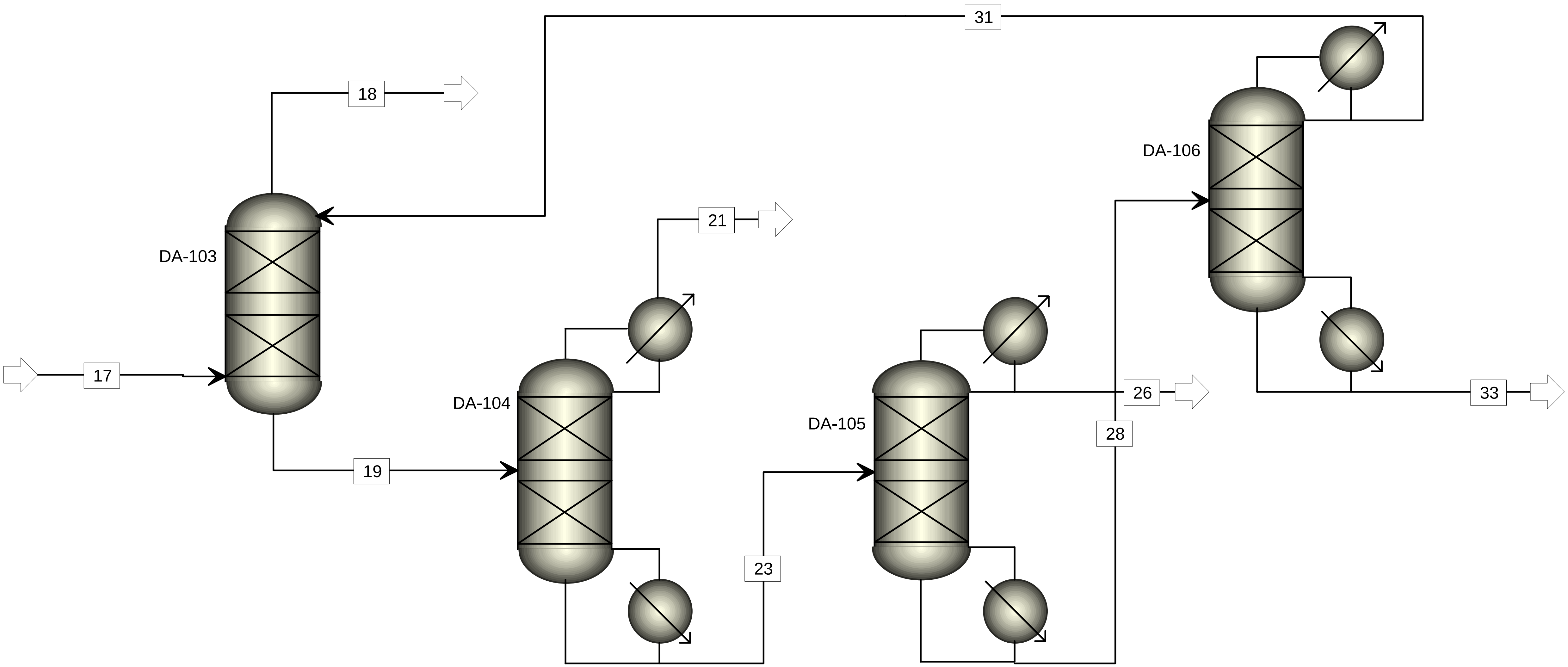
Overall Flowsheet for DME Production Unit



DME Production Unit Simulation Using A+



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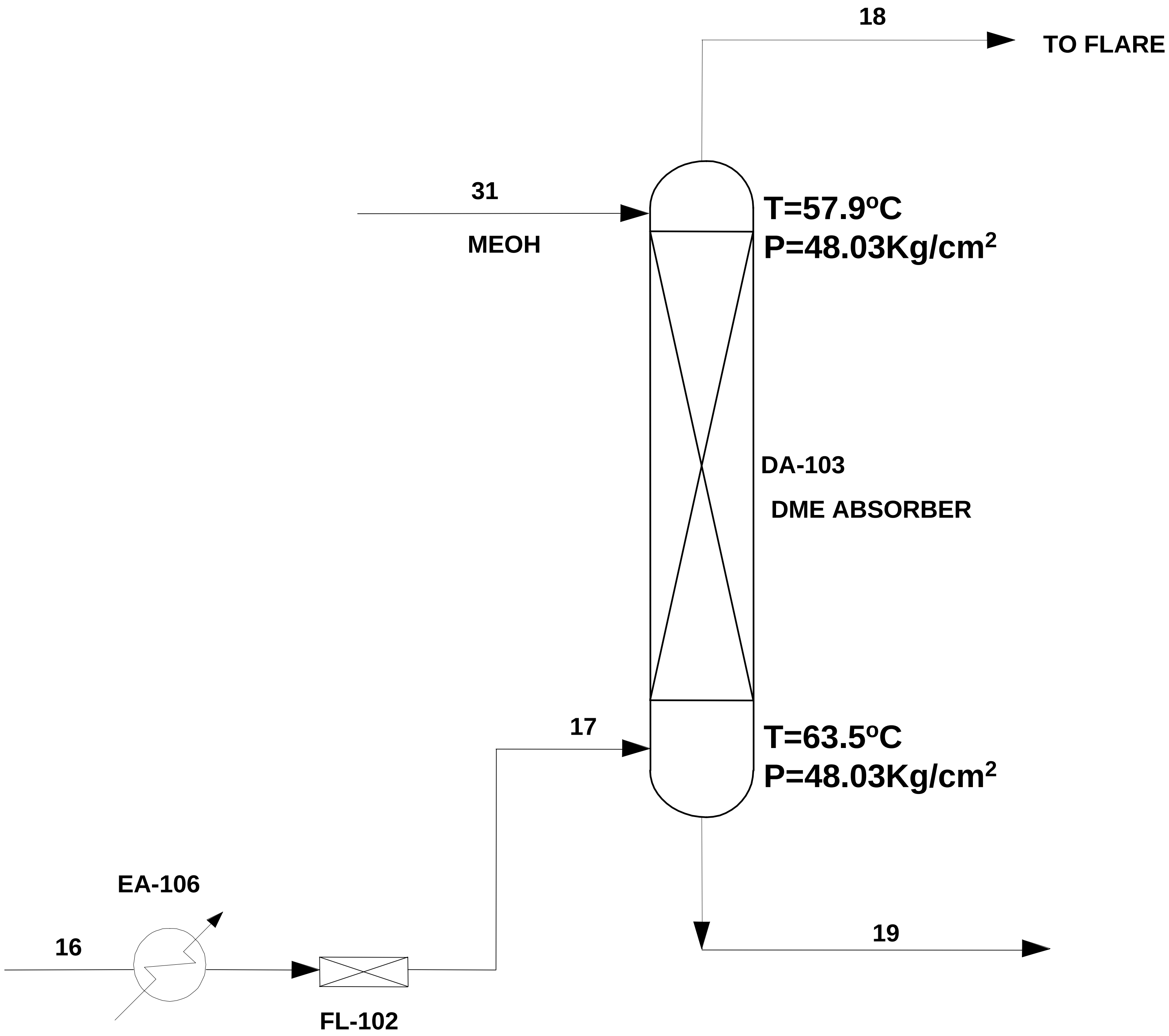
Flowsheet for Toluene Recovery Process

Unit	Description
DA-103	DME Absorber
DA-104	CO2 Stripper
DA-105	DME Column
DA-106	MEOH Recovery Column
Stream	**Description**
17	DME Synthesis Reactor Outlet to DME Absorber Feed Stream
18	DME Absorber OVHD Gas Stream to Flare
19	DME Absorber BTMS Stream
21	CO2 Stripper OVHD Gas Stream
23	CO2 Stripper BTMS Stream
26	DME Column OVHD Stream
28	DME Column BTMS Stream
31	MEOH Recovery Column OVHD Stream Recycled to DME Absorber
33	MEOH Recovery Column BTMS Stream

Overall Material Balance

	17	18	19	21	23	26	28	31	33
Phase	Mixed	Vapor	Liquid	Vapor	Liquid	Liquid	Liquid	Liquid	Liquid
Molar Percent									
H2	49.2044	63.3394	0.5511	9.7249	7.32E-14	4.52E-13	0.0000	0.0000	0.0000
CO	5.7191	7.2161	0.1919	3.3869	8.19E-14	5.06E-13	0.0000	0.0000	0.0000
CO2	19.2281	20.2310	4.1787	73.7331	2.75E-04	1.70E-03	6.77E-12	7.27E-12	0.0000
CH4	0.4620	0.5795	0.0185	0.3270	4.34E-14	2.68E-13	0.0000	0.0000	0.0000
N2	0.0584	0.0748	9.63E-04	0.0170	2.26E-15	1.40E-14	0.0000	0.0000	0.0000
H2O	3.4594	0.0148	5.7143	3.236E-5	6.0576	5.61E-03	7.2264	2.4255	73.1028
DME	19.4806	7.0841	17.0556	12.8111	17.1306	**99.9927**	1.3430	1.4409	0.0000
MEA	2.3854	1.4602	72.2858	3.084E-6	76.6284	2.92E-06	91.4268	96.1336	26.8411
MEOH	2.64E-03	2.37E-20	3.009E-3	0.0000	3.19E-03	0.0000	3.81E-03	2.64E-16	0.0560
MW (Kg/Kmol)	21.5106	16.0500	33.9587	39.5540	33.6216	46.0684	31.2179	31.9039	21.8041
Flow rate (K-mole/hr)	67.6140	52.0089	59.3237	3.3619	55.9618	9.0580	46.9038	43.7177	3.1860
Flow rate (Ton/day)	**34.896**	**20.040**	**48.336**	**3.192**	**45.168**	**10.000**	**35.136**	**33.480**	**1.668**
Temperature (^oC)	45.0000	57.8774	63.7119	14.0000	110.2622	46.0000	125.8043	42.0432	89.7695

1st Column: DA-103 (DME Absorber)



DME Absorber Simulation (DA-103)

- Primary objective of the absorber is to recovery DME as an absorber bottom product by using methanol as a solvent.

DME Absorber Simulation *Continued*

- Consider the following absorber distillation to produce a purified toluene using sulfolane as a solvent.
  - Feed1: Crude Feed (Refer to feedstock characterization)
  - Feed2: Methanol Solvent

    1) Solvent Feed Temperature: 45^oC

    2) Flowrate: 67.614 K-mole/hr
  - DME Absorber Column

    1) Number of Theoretical Stages: 7

    3) Overall Tray Efficiencies:

    4) Feed Tray Location: 7

    6) Solvent Feed Tray Location: 1

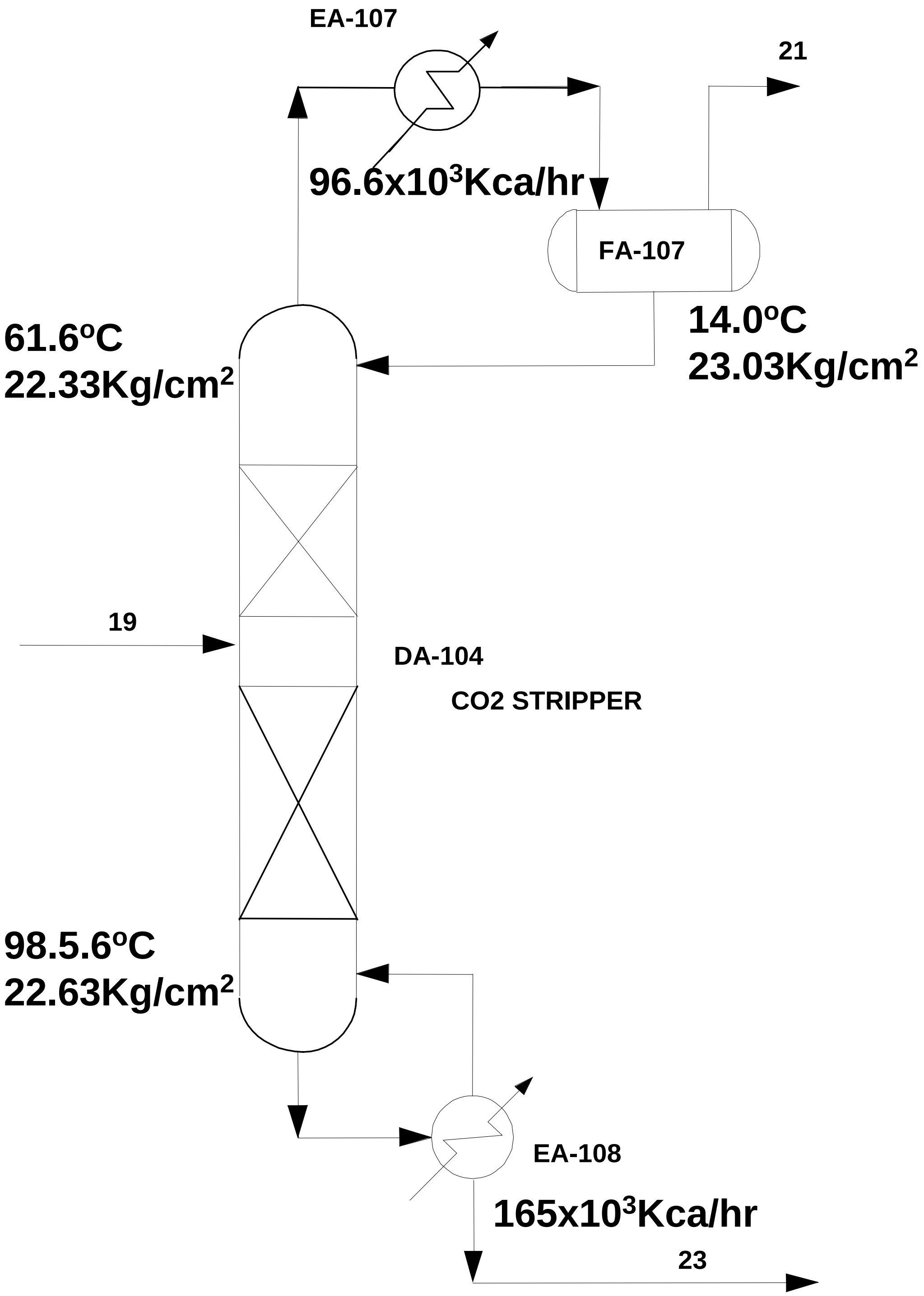
DME Absorber Simulation *Continued*

- Selection of appropriate thermodynamic model for the simulation of DME absorber using methanol as a solvent is very important.
  - NRTL (Non Random Two Liquid) activity coefficient model was chosen to explain non-ideal phase behavior of liquid mixture between H_2O, DME, methanol and MEA.
  - Henry's law option was also selected for the calculation of non-condensible supercritical gases like H_2, CO, CO_2, CH_4 and N_2 in a liquid mixture.

Material Balance Around DA-103

	17	31	18	19
Phase	Mixed	Liquid	Vapor	Liquid
Molar Percent				
H_2	49.2044	0.0000	63.3394	0.5511
CO	5.7191	0.0000	7.2161	0.1919
CO_2	19.2281	7.27E-12	20.2310	4.1787
CH_4	0.4620	0.0000	0.5795	0.0185
N_2	0.0584	0.0000	0.0748	9.63E-04
H_2O	3.4594	2.4255	0.0148	5.7143
DME	19.4806	1.4409	7.0841	17.0556
MEA	2.3854	96.1336	1.4602	72.2858
MEOH	2.64E-03	2.64E-16	2.37E-20	3.009E-3
MW (Kg/Kmole)	21.5106	31.9039	16.0500	33.9587
Flow rate (K-mole/hr)	67.6140	43.7177	52.0089	59.3237
Flow rate (Ton/day)	**34.896**	**33.480**	**20.040**	**48.336**
Temperature (^oC)	45.0000	42.0432	57.8774	63.7119
Pressure (Kg/cm^2)	52.0330	1.333	48.0330	48.0330

2nd Column: DA-104 (CO2 Stripper)



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CO2 Stripper Simulation

- Primary objective of the CO2 Stripper is to strip CO2 dissolved in the liquid feed stream at column top product.

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CO2 Stripper Simulation *Continued*

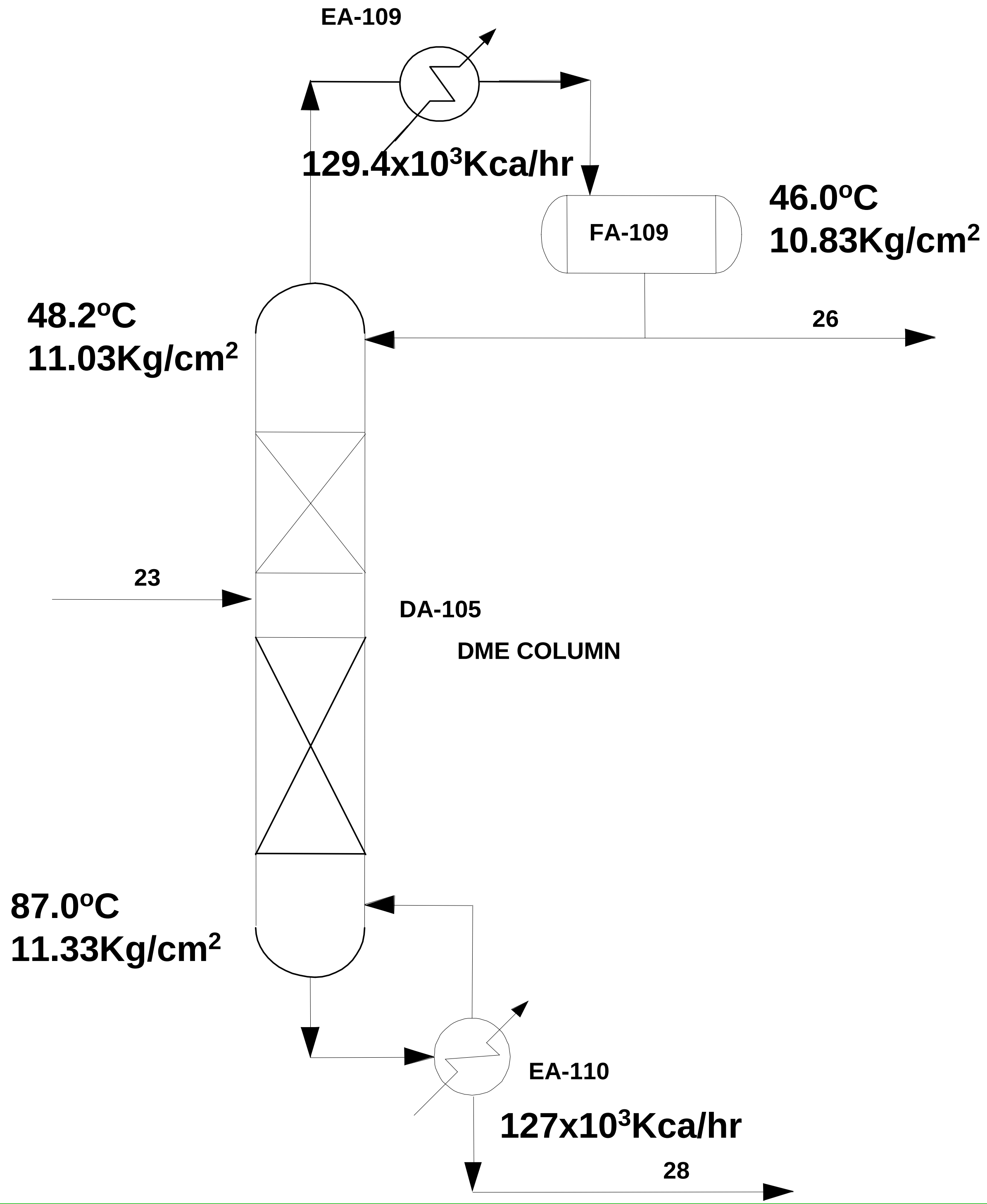
- Selection of appropriate thermodynamic model for the simulation of DME absorber using methanol as a solvent is very important.

  - NRTL (Non Random Two Liquid) activity coefficient model was chosen to explain non-ideal phase behavior of liquid mixture between H_2O, DME, methanol and MEA.
  - Henry's law option was also selected for the calculation of non-condensible supercritical gases like H_2, CO, CO_2, CH_4 and N_2 in a liquid mixture.

Material Balance Around CO_2 Stripper

	19	21	23
Phase	Liquid	Vapor	Liquid
Molar Percent			
H_2	0.5511	9.7249	7.32E-14
CO	0.1919	3.3869	8.19E-14
CO_2	4.1787	73.7331	2.75E-04
CH_4	0.0185	0.3270	4.34E-14
N_2	9.63E-04	0.0170	2.26E-15
H_2O	5.7143	3.236E-5	6.0576
DME	17.0556	12.8111	17.1306
MEA	72.2858	3.084E-6	76.6284
MEOH	3.009E-3	0.0000	3.19E-03
MW (Kg/Kmole)	33.9587	39.5540	33.6216
Flow rate (K-mole/hr)	59.3237	3.3619	55.9618
Flow rate (Ton/day)	**48.336**	**3.192**	**45.168**
Temperature (^oC)	63.7119	14.0000	110.2622
Pressure (Kg/cm^2)	48.0330	22.0330	22.6330

3rd Column: DA-105 (DME Column)



DME Column Simulation

- Primary objective of the DME column is to recovery DME as a top product.

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DME Column Simulation *Continued*

- Consider the following DME column to obtain a purified DME as a top product.
  - Feed: CO_2 Stripper Bottom Stream (Refer to feedstock characterization)

    1) DME Product Purity = 99.9 by mole %

  - DME Column

    1) Number of Theoretical Stages: 20

    3) Overall Tray Efficiencies: Can by estimated by correlation

    4) Feed Tray Location: 11

DME Column Simulation *Continued*

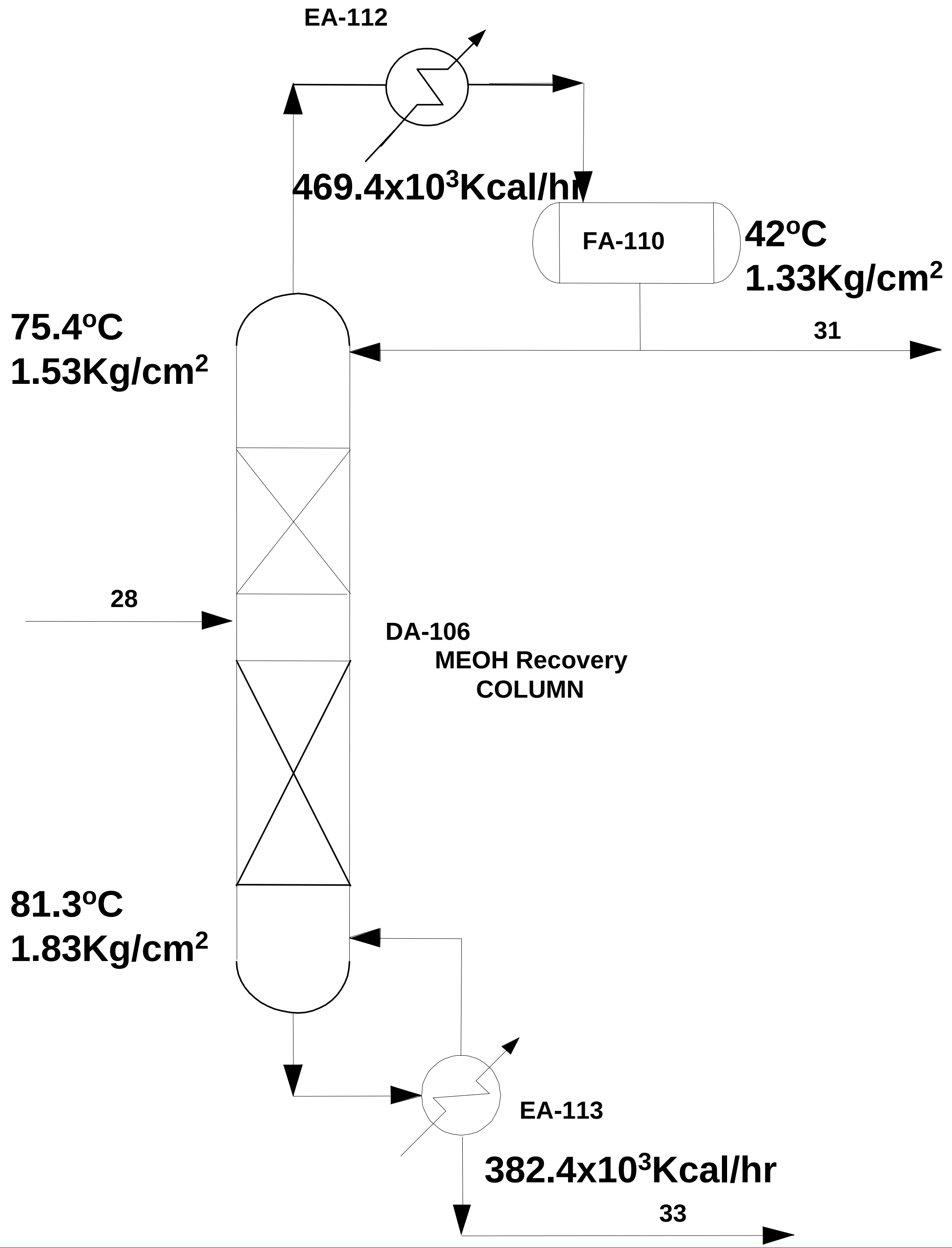
- Selection of appropriate thermodynamic model for the simulation of DME Column is very important.

  - NRTL (Non Random Two Liquid) activity coefficient model was chosen to explain non-ideal phase behavior of liquid mixture between H2O, DME, methanol and MEA.
  - Henry’s law option was also selected for the calculation of non-condensible supercritical gases like H2, CO, CO2, CH4 and N2 in a liquid mixture.

Material Balance Around DA-105

	23	26	28
Phase	Liquid	Liquid	Liquid
Molar Percent			
H_2	7.32E-14	4.52E-13	0.0000
CO	8.19E-14	5.06E-13	0.0000
CO_2	2.75E-04	1.70E-03	6.77E-12
CH_4	4.34E-14	2.68E-13	0.0000
N_2	2.26E-15	1.40E-14	0.0000
H_2O	6.0576	5.61E-03	7.2264
DME	17.1306	99.9927	1.3430
MEA	76.6284	2.92E-06	91.4268
MEOH	3.19E-03	0.0000	3.81E-03
MW (Kg/Kmole)	33.6216	46.0684	31.2179
Flow rate (K-mole/hr)	55.9618	9.0580	46.9038
Flow rate (Ton/day)	**45.168**	**10.000**	**35.136**
Temperature (^oC)	110.2622	46.0000	125.8043
Pressure (Kg/cm^2)	22.6330	10.8330	11.0330

4th Column: DA-106 (MEOH Recovery Column)



MEOH Recovery Column Simulation

- Primary objective of the MEOH Recovery Column is to recovery MEOH as a top product.

MEOH Recovery Column Simulation *Continued*

- Consider the following MEOH Recovery Column to recover methanol stream as a top product.
  - Feed: DME Column BTMS Stream (Refer to feedstock characterization)

    1) Methanol Purity at Column Top: > 94 mole%

  - MEOH Column

    1) Number of Theoretical Stages: 20

    3) Overall Tray Efficiencies: Can be Estimated by Correlation

    4) Feed Tray Location: 11

MEOH Recovery Column Simulation *Continued*

- Selection of appropriate thermodynamic model for the simulation of MEOH Recovery Column is very important.

  - NRTL (Non Random Two Liquid) activity coefficient model was chosen to explain non-ideal phase behavior of liquid mixture between H2O, DME, methanol and MEA.
  - Henry’s law option was also used for the calculation of noncondensible supercritical gases in a mixed solvent.

Material Balance Around DA-106

	28	31	33
Phase	Liquid	Liquid	Liquid
Molar Percent			
H2	0.0000	0.0000	0.0000
CO	0.0000	0.0000	0.0000
CO2	6.77E-12	7.27E-12	0.0000
CH4	0.0000	0.0000	0.0000
N2	0.0000	0.0000	0.0000
H2O	7.2264	2.4255	73.1028
DME	1.3430	1.4409	0.0000
MEA	91.4268	96.1336	26.8411
MEOH	3.81E-03	2.64E-16	0.0560
MW (Kg/Kmole)	31.2179	31.9039	21.8041
Flow rate (K-mole/hr)	46.9038	43.7177	3.1860
Flow rate (Ton/day)	**35.136**	**33.480**	**1.668**
Temperature (^oC)	125.8043	42.0432	89.7695
Pressure (Kg/cm^2)	11.0330		1.5330

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