# PROSIM DAC APPLICATION EXAMPLE

# VTSA PROCESS FOR DIRECT ADSORPTION OF CO₂ FROM AIR

| EXAMPLE PURPOSE |
|---|
| This example deals with a VTSA (Vacuum Thermal Swing Adsorption) process for the direct adsorption of $CO_2$ from the air. A thermodynamic adsorption model is used to take into account the effect of air humidity on $CO_2$ adsorption. This process is modeled in *ProSim DAC*, Fives ProSim's dynamic simulation software dedicated to gas-solid adsorption columns. |

| ACCESS | ☑ Free Internet | ☐ Restricted to clients | ☐ Restricted | ☐ Confidential |
|---|---|---|---|---|

| CORRESPONDING PROSIM DAC FILES | *PSPDYN_EN_FR-DAC.pmp3* |
|---|---|

*Reader is reminded that this use case is only an example and should not be used for other purposes. Although this example is based on actual case it may not be considered as typical nor are the data used always the most accurate available. Fives ProSim shall have no responsibility or liability for damages arising out of or related to the use of the results of calculations based on this example.*

# CONTENTS

# 1. PROCESS MODELING

## 1.1. Process description

Carbon dioxide ($CO_2$) is a common compound in the air and also the most important component of greenhouse gases [HAJ18b]. At present, about 44% of carbon dioxide comes from the combustion of fossil fuels such as oil, coal, and compressed natural gas [ZHA13]. In 1958, the concentration of carbon dioxide in the environment was about 315 ppm. In 1986, it had reached 350 ppm and in 2013, it exceeded 400 ppm. In addition, carbon dioxide emissions in 2040 are expected to increase by more than 40% compared to 2010 emissions.

Many techniques for capturing $CO_2$ from the atmosphere, such as membrane separation, chemical absorption by various solvents (ionic liquids [RAZ16], nano-fluids [HAJ18a], amino acid salt solutions [SOR19], etc.), electrochemical separation, low-temperature separation, solid adsorption, and other carbon capture technologies, have been investigated. Solid adsorption technology has become one of the most commonly used methods for $CO_2$ capture due to the low cost of solid adsorbents and low energy consumption in the adsorption process [WAL08]. The TSA (Temperature Swing Adsorption), PTSA (Pressure Temperature Swing Adsorption) and VTSA (Vacuum Temperature Swing Adsorption) processes are the most commonly encountered in the literature for the direct adsorption of $CO_2$ [JIA23].

This example is based on the publication [BAL24]. This publication describes the adsorption in a laboratory column of wet air containing $CO_2$ on a bed of APDES-NFC-FD-S which is a chemisorbent functionalized by amines (3-aminopropylmethyldiethoxysilane). *ProSim DAC* automatically calculates the amount of water to be added to air to meet the specified relative humidity. The process is a VTSA (Vacuum Thermal Swing Adsorption) process. Adsorption takes place at atmospheric pressure. The short pressure regeneration (80 s) corresponds to the vacuum step. The bed is regenerated mainly during the temperature regeneration step. This step is co-current with respect to adsorption. The air flow to be decarbonized enters the "Adsorption column" via the "Air+CO2" stream. The hot air for temperature regeneration enters the column via the "Hot_Air" stream. The "LP_Air" stream represents the low-pressure air sweep after the depressurization step. But this flow is not used in this simulation. The carbon-free air leaves the column via the "Air" stream. The flow of $CO_2$ and water leaving the column during regeneration constitutes the "CO2+H2O" stream.

## 1.2. Simulation flowsheet

The simulation flowsheet is shown in the following figure.
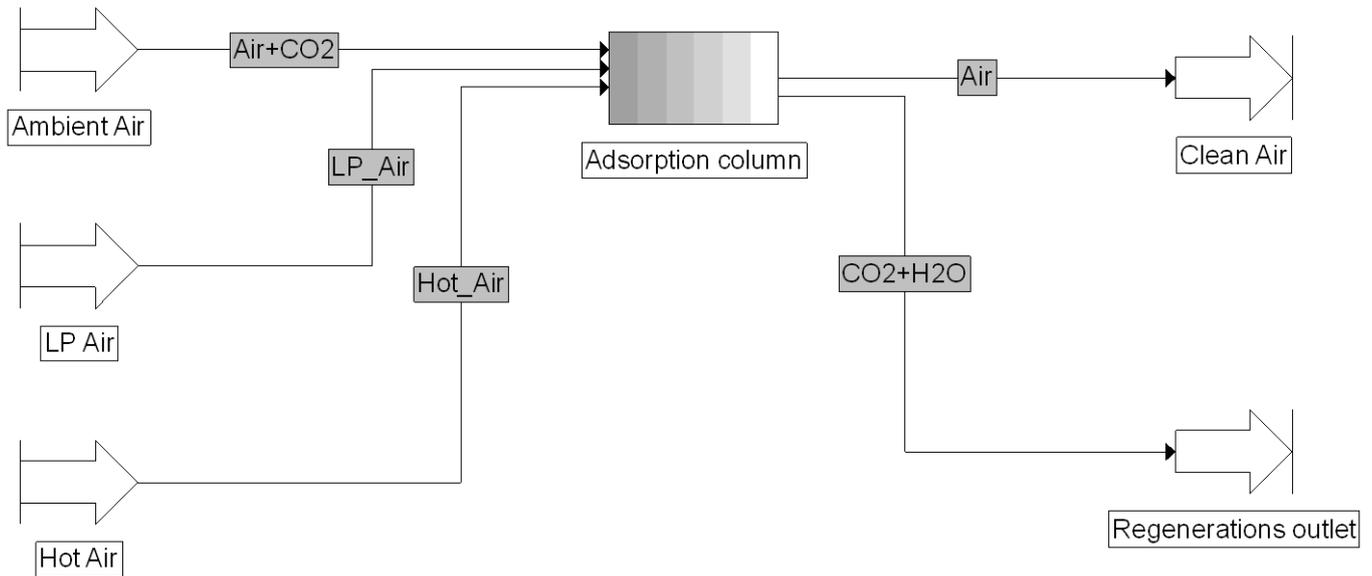


## 1.3. Compounds

The compounds considered in the simulation, their chemical formulae and CAS® numbers[1] are presented in the table below. Their pure compound properties are extracted from the standard database provided with *ProSim DAC* [ROW24].

| Compound | Chemical formula | CAS number |
|---|---|---|
| Air | | |
| Carbon dioxide | $CO_2$ | 124-38-9 |
| Water | $H_2O$ | 7732-18-5 |

## 1.4. Thermodynamic model

Adsorption and regenerations are carried out at pressures equal to or lower than atmospheric pressure and at temperatures below 102°C. Thus, the "Ideal" thermodynamic profile is selected in the Simulis Thermodynamics calculator.

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[1] *CAS Registry Numbers® are the intellectual property of the American Chemical Society and are used by Fives ProSim SAS with the express permission of ACS. CAS Registry Numbers® have not been verified by ACS and may be inaccurate.*

## 1.5. <u>Operating parameters</u>

### 1.5.1. Process feeds

The characteristics of the three process feeds are described in the table below.

| | Ambient Air | LP Air | Hot Air |
|---|---|---|---|
| **Temperature (°C)** | 20 | 20 | 120 |
| **Pressure (bar)** | 1.01325 | 0.050 | 0.050 |
| **Total flow rate (cm³/s)** | 50 | 25 | 25 |
| **Relative humidity (%)** | 49.82 | 0 | 0 |
| **Molar fractions** | | | |
| **Air** | 0.999595 | 1 | 1 |
| **Carbon dioxide** | 0.000405 | 0 | 0 |
| **Water** | 0* | 0 | 0 |

* The water content required to achieve the specified relative humidity will be automatically calculated by the corresponding "Feed" module.

The following screenshot shows the configuration of the "Ambient Air" feed.
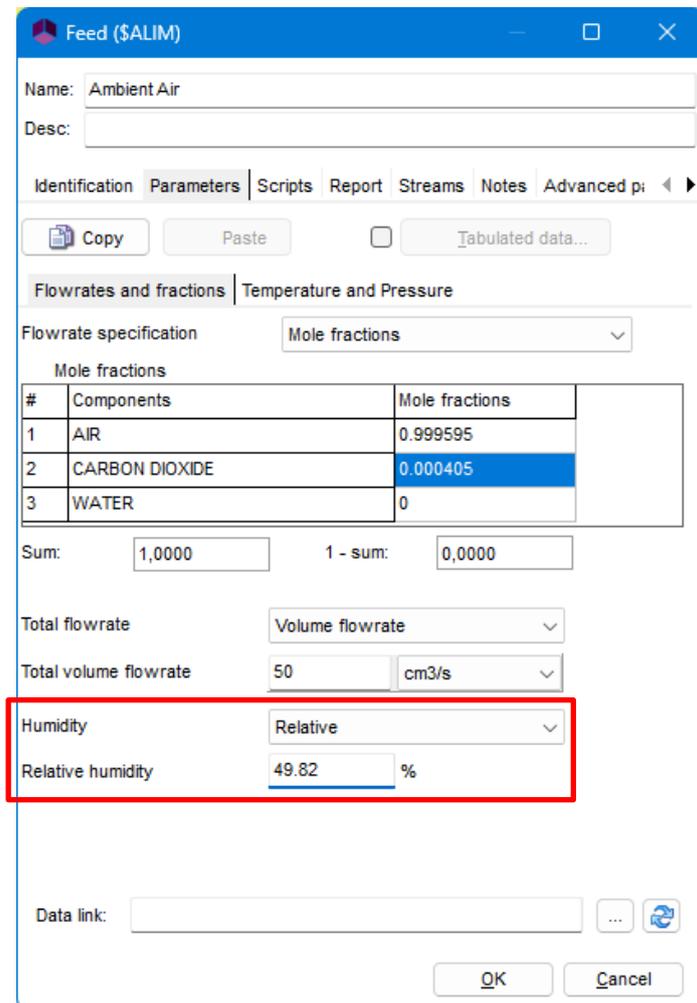
### 1.5.2. Simulation duration

The "Final time" is the actual operating time of the operation (adsorption + vacuum regeneration + temperature regeneration in this example). The "Final time" is entered in the *ProSim DAC* icon bars:
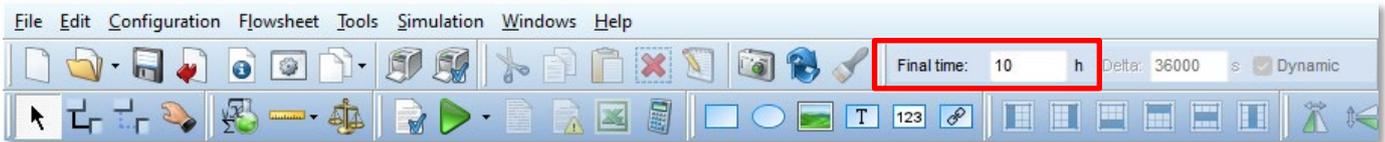


| Simulation duration | Value |
|---|---|
| Final time | 10 h |

### 1.5.3. Adsorption column

#### 1.5.3.1. Feeds

Four feeds can be used in *ProSim DAC*:

- ✓ Adsorbates flow:      Flux to be purified during the adsorption step
- ✓ Flow for the thermal regeneration:      Flow used during the temperature regeneration (hot inert, water vapor, etc.)
- ✓ Flow for the pressure regeneration:      Flow used during the pressure regeneration (inert at pressure lower than the one of adsorption, etc.)
- ✓ Flow for the cooling:      Flow used to cool the column at the end of the temperature regeneration step

The first three feeds are used in this example as shown in the screenshot below.
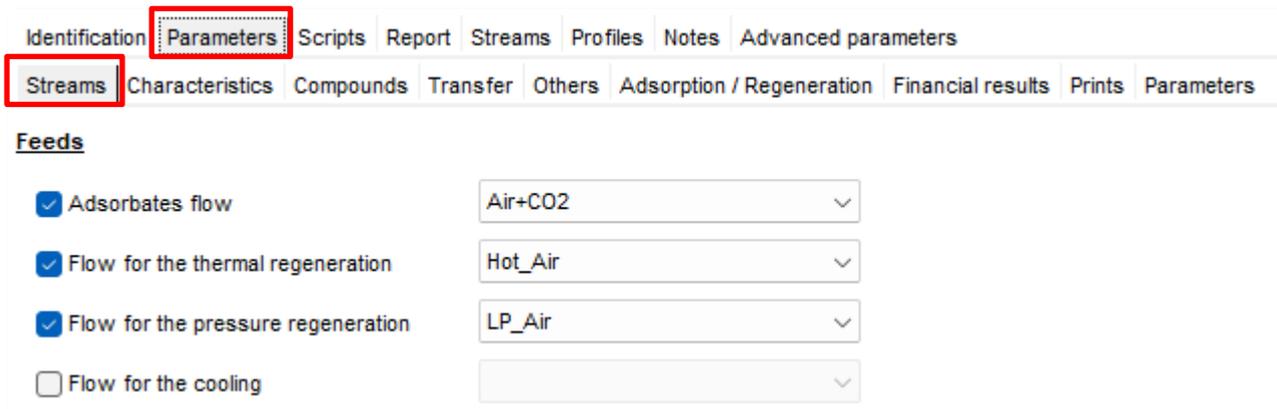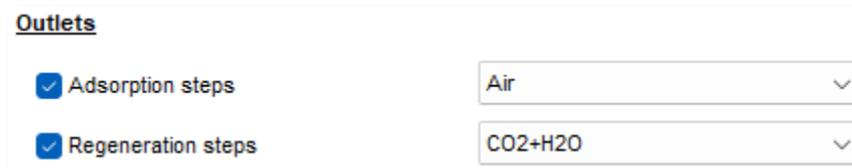
### 1.5.3.2. Outlets

Two outlets can be used in *ProSim DAC*:

✓ Adsorption steps:     Outlet during the adsorption steps
✓ Regeneration steps:   Outlet during the regeneration steps

The screenshot below shows the outlets used.



### 1.5.3.3. Column characteristics

The column used is a lengthwise flow column. Its characteristics are shown in the screenshot below. The dimensions to be provided are those of the adsorbent bed. It should be noted that *ProSim DAC* also allows to model a transverse flow column.
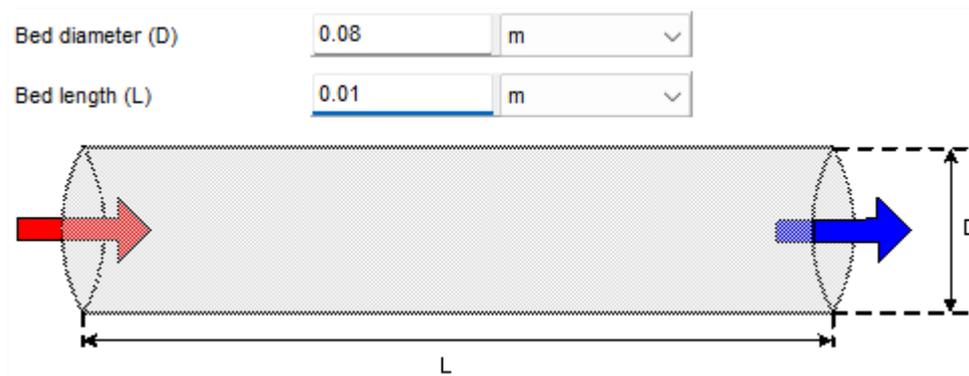


### 1.5.3.4. Thermal behavior

*ProSim DAC* allows you to model the following heat exchange modes:

✓ Heat exchange in the bed: "Given heat duty without wall transfer"
This possibility allows to model an adiabatic operation or an operation at given amount of heat duty for each step (exchanger within the adsorbent bed).

✓ Transfer through the wall + heat exchange in the bed: "Given heat duty and wall transfer "
Heat exchange takes place through the column wall. The wall temperature is by default constant over time and along the column. To overcome this hypothesis, it is necessary to activate the "Take into account thermal inertia of the column wall" option. It is possible to add to this transfer mode a given amount of heat in the adsorption bed for each step (by default zero).

In this example, the heat transfer takes place through the column wall and without direct heat input into the adsorbent bed. The wall temperature specified in the "Characteristics" tab is the temperature of the wall during the regeneration steps. The wall temperature during the adsorption step is specified later.

| Thermal behavior | |
|---|---|
| Thermal transfer | Given heat duty and wall transfer |
| Wall temperature | 120°C |

### 1.5.3.5. Bed adsorbent characteristic

| Bed adsorbent characteristic | |
|---|---|
| Bed void ratio | 0.092 m$^3$/m$^3$ |

### 1.5.3.6. Adsorbent characteristics

The density of the particles takes into account the intra-particle porosity. The surface-to-volume ratio is the ratio between the geometric surface and the geometric volume of one of the particles.

| Particles characteristics | |
|---|---|
| Diameter | 7,5 mm |
| Density | 61 kg/m$^3$ |
| Specific heat | 2 070 J/kg/K |
| Surface/volume ratio | 800 m$^2$/m$^3$ |

### 1.5.3.7. Measures conditions for concentration results

The user can specify the temperature and pressure conditions that he wants to use to calculate the volume concentrations in the gas phase. Indeed, density is then necessary and, particularly in the case of a gas, is sensitive to temperature and pressure. In this example, the volume concentrations in the gas phase are evaluated under normal temperature and pressure conditions.

| Measures conditions | Value |
|---|---|
| Conditions | Normal |

### 1.5.3.8. Initialization

It is necessary to set the state of the column at startup. In this example, it is assumed that the column is at the temperature at the end of the temperature regeneration and at the composition of the air to be purified.

| Initialization | Value |
|---|---|
| Type | Supplied by suer |
| Pressure | 1 atm |
| Temperature | 120°C |
| Molar factions<br>Air<br>Carbon dioxide<br>Water | <br>0.9881<br>0.0004<br>0.0115 |

The screenshot below shows the information from the previous paragraphs (from paragraph 1.5.3.3. to paragraph 1.5.3.8. included) entered into the module interface: "Parameters" tab, "Characteristics" sub-tab.

### 1.5.3.9. Adsorption isotherm

It is assumed that air does not adsorb. It is represented by a linear isotherm with the parameters of the table below.

$$q_i = K_0 exp\left(\frac{K_1}{T}\right) P_i$$

| | |
|---|---|
| **$K_0$ (mol/kg/atm)** | 0 |
| **$K_1$ (K)** | 0 |
| **$\Delta H_{ads}$ (J/mol)** | 0 |

The generalized Toth isotherm was chosen for carbon dioxide:

$$q_i = \frac{q_s b P_i}{[K + (bP_i)^\omega]^{1/\omega}}$$

$$q_s = q_{s,0} exp\left[\chi\left(1 - \frac{T}{T_0}\right)\right] \qquad b = b_0 exp\left[-\frac{\Delta H_a}{RT_0}\left(\frac{T_0}{T} - 1\right)\right] \qquad \omega = \omega_0 + \alpha\left(1 - \frac{T}{T_0}\right)$$

| | |
|---|---|
| **$q_{s0}$ (mol/kg)** | 2.2 |
| **$b_0$ (atm$^{-1}$)** | 37 794.225 |
| **$\omega_0$ (-)** | 0.4247 |
| **$\chi$ (-)** | 0 |
| **$\Delta H_a$ (J/mol)** | -60 000 |
| **$\alpha$ (-)** | -0.4921 |
| **$T_0$ (K)** | 296 |
| **$K$ (-)** | 1 |
| **$\Delta H_{ads}$ (J/mol)** | -60 000 |

The GAB isotherm (Guggenheim - Anderson - de Boer) was chosen for water:

$$q_i = \frac{C_m C_G K_{ads} \frac{P_i}{P_i^{sat}}}{\left(1 - K_{ads}\frac{P_i}{P_i^{sat}}\right)\left(1 + (C_G - 1)K_{ads}\frac{P_i}{P_i^{sat}}\right)}$$

$$C_m = C_{m0} exp\left(\frac{\beta}{T}\right) \qquad C_G = C_{G0} exp\left(\frac{\Delta H_C}{RT}\right) \qquad K_{ads} = K_{ads0} exp\left(\frac{\Delta H_K}{RT}\right)$$

| | |
|---|---|
| **$C_{m0}$ (mol/kg)** | 36.48 |
| **$C_{G0}$ (-)** | 0.1489 |
| **$K_{ads}$ (-)** | 0.5751 |
| **$\beta$ (K)** | 0 |
| **$\Delta H_C$ (J/mol)** | 0 |
| **$\Delta H_K$ (J/mol)** | 0 |
| **$\Delta H_{ads}$ (J/mol)** | -43 800 |

This information must be provided in the "Parameters" tab, "Compounds" sub-tab:

Identification | Parameters | Scripts | Report | Streams | Profiles | Notes | Advanced parameters

Streams | Characteristics | Compounds | Transfer | Others | Adsorption / Regeneration | Financial results | Prints | Parameters

**Characteristics**

→ AIR
CARBON DIOXIDE
WATER

**Adsorption enthalpy**

Enthalpy of adsorption — Given

Adsorption heat — 0 — cal/mol — Load...

**Adsorption isotherm**

Correlation — Linear isotherm

$$q_i = K_0 \, \exp\left(\frac{K_1}{T}\right) P_i$$

K0 — 0 — mol/kg/atm

K1 — 0 — K

---

AIR
→ CARBON DIOXIDE
WATER

**Adsorption enthalpy**

Enthalpy of adsorption — Given

Adsorption heat — -60000 — J/mol — Load...

**Adsorption isotherm**

Correlation — Generalized Toth

$$q_i = \frac{q_{s,0}\exp\left[\chi\left(1-\frac{T}{T_0}\right)\right] b_0\exp\left[-\frac{\Delta H_a}{RT_0}\left(\frac{T_0}{T}-1\right)\right] P_i}{\left[K+\left(b_0\exp\left[-\frac{\Delta H_a}{RT_0}\left(\frac{T_0}{T}-1\right)\right]P_i\right)^{\omega_0+\alpha\left(1-\frac{T}{T_0}\right)}\right]^{1/\left(\omega_0+\alpha\left(1-\frac{T}{T_0}\right)\right)}}$$

| | | | | |
|---|---|---|---|---|
| qs0 | 2,2 | mol/kg | ΔHa | -60000 | J/mol |
| b0 | 37794,225 | atm⁻¹ | α | -0,4921 | |
| w0 | 0,4247 | | T0 | 296 | K |
| χ | 0 | | K | 1 | |

---

AIR
CARBON DIOXIDE
→ WATER

**Adsorption enthalpy**

Enthalpy of adsorption — Given

Adsorption heat — -43800 — J/mol — Load...

**Adsorption isotherm**

Correlation — GAB (Guggenheim - Anderson - de Boer)

$$q_i = \frac{C_{m0}\exp\left(\frac{\beta}{T}\right) C_{G0}\exp\left(\frac{\Delta H_c}{RT}\right) K_{ads0}\exp\left(\frac{\Delta H_K}{RT}\right)\frac{P_i}{P_i^{sat}}}{\left(1-K_{ads0}\exp\left(\frac{\Delta H_K}{RT}\right)\frac{P_i}{P_i^{sat}}\right)\left(1+\left(C_{G0}\exp\left(\frac{\Delta H_c}{RT}\right)-1\right)K_{ads0}\exp\left(\frac{\Delta H_K}{RT}\right)\frac{P_i}{P_i^{sat}}\right)}$$

| | | | | |
|---|---|---|---|---|
| Cm0 | 36,48 | mol/kg | ΔHc | 0 | J/mol |
| CG0 | 0,1489 | | ΔHk | 0 | J/mol |
| Kads0 | 0,5751 | | | | |
| β | 0 | K | | | |

### 1.5.3.10. Mass transfer

The following options are available for mass transfer:

- ✓ Coupled gas and solid phase transfer
- ✓ Mass transfer resistance ("Linear Driving Force") in the gas and/or the solid phase, the necessary mass transfer coefficients can be provided by the user or calculated by *ProSim DAC*. It is also possible to neglect the transfer resistances.

In this example, the mass transfer resistance has been considered only in the solid phase. The mass transfer coefficients are specified.

| | **Value** |
|---|---|
| **Mass transfer** | |
| Type | Gas and solid transfer |
| **Gas mass transfer** | |
| Type | No resistance |
| **Solid mass transfer** | |
| Type <br>    Air <br>    Carbon dioxide <br>    Water | kf supplied <br> $0 \text{ s}^{-1}$ <br> $0.0002 \text{ s}^{-1}$ <br> $0.001 \text{ s}^{-1}$ |

### 1.5.3.11. Thermal transfer

It's possible to take into account or to ignore the enthalpy balance in *ProSim DAC*. Not taking into account the enthalpy balance makes possible to simulate isothermal operation. When enthalpy balances are taken into account, the calculations require the knowledge of the gas-adsorbent and gas-wall heat transfer coefficients. These can be calculated or provided, as in this example. The value for the gas-adsorbent transfer is due to the fact that this transfer should not be limiting in this example.

| **Thermal transfer** | **Value** |
|---|---|
| Enthalpy balances | Taken into account |
| Gas – Adsorbent | $1\,000\,000 \text{ W/m}^2\text{/K}$ |
| Gas – Wall | $3 \text{ W/m}^2\text{/K}$ |

The screenshot below shows the information of paragraphs 1.5.3.10. and 1.5.3.11. entered in the module's interface: "Parameters" tab, "Transfer" sub-tab.

Identification | Parameters | Scripts Report Streams Profiles Notes Advanced parameters

Streams Characteristics Compounds Transfer | Others Adsorption / Regeneration Financial results Prints Parameters

**Mass transfer**

Transfer type — Gas and solid transfer

**Gas mass transfer**

Gas transfer type — No resistance

**Thermal transfer**

☑ Enthalpy balances ?

Gas-adsorbent — Supplied

Exchange coefficient — 1000000 — W/m2/K

Gas-wall — Supplied

Exchange coefficient — 3 — W/m2/K

**Wall thermal inertia**

☐ Take into account thermal inertia of the column wall

| Mass (wall) | 0 | kg |
| Specific heat (wall) | 0 | cal/g/K |
| Thickness (wall) | 0 | m |
| Thermal conductivity | 0 | W/m/K |
| Wall-outside transfer coefficient | | Given |
| Coefficient | 4,0000009560229 | kcal/h/m2/K |

**Solid mass transfer**

Solid transfer type — kf supplied

Mass transfer coefficients of solid phase    (s⁻¹)

| | | |
|---|---|---|
| 1 | AIR | 0 |
| 2 | CARBON DIOXIDE | 0.0002 |
| 3 | WATER | 0.001 |

### 1.5.3.12. Adsorption thermodynamic model

For this example, the thermodynamic adsorption model of Stampi – Bombelli is used. This model takes into account the positive effect of the stream humidity on the adsorption of carbon dioxide. This model is more specifically developed to correct two of the parameters of the generalized Toth isotherm by a function of the adsorbed quantity of water.

$$q_{s,wet} = q_s \left( \frac{1}{1 - \Psi q_{H_2O}} \right)$$

$$b_{wet} = b\left(1 + \beta q_{H_2O}\right)$$

| | |
|---|---|
| **Main adsorbent** | Carbon dioxide |
| **Co-adsorbent** | Water |
| **ψ (kg/mol)** | 0.00958 |
| **β (kg/mol)** | 3.448 |

### 1.5.3.13.   Sequence

The "Adsorption / Regeneration" sub-tab of the "Parameters" tab allows you to choose the type of cycle to simulate among the five available:

1. Adsorption only

2. Adsorption + thermal regeneration

3. Adsorption + pressure regeneration

4. Adsorption + pressure regeneration + thermal regeneration

5. Adsorption + thermal regeneration + pressure regeneration

The "Adsorption + pressure regeneration + thermal regeneration" cycle is used in this example to model a VTSA (Vacuum Thermal Swing Adsorption) process as shown in the screenshot below.

The parameters of the adsorption step are:

| Adsorption | |
|---|---|
| Column cooling through the wall | Yes |
| Wall temperature | 20°C |
| Other parameters | Default value |
| Event | Duration = 13 772 s |

The parameters of the pressure regeneration step are:

| Pressure regeneration | |
|---|---|
| Pressure to reach | 50 mbar |
| Pressure down duration | 80 s |
| Pressure up duration | 0 s |
| Valve coefficient | $10^{-6}$ |
| Other parameters | Default value |
| Event | Duration = 80 s |

The parameters of the thermal regeneration step are:

| Thermal regeneration | |
|---|---|
| Regeneration type | Co-curent |
| Other parameters | Default value |
| Event | Duration = 22 148 s |

The simulation end event is:

| End of simulation | |
|---|---|
| Event | Temps de fin de simulation |

### 1.5.3.14. Financial balance

*ProSim DAC* carries out a financial balance on the regeneration steps. If the user is interested, it is possible to change the default parameters in the "Financial balance" sub-tab of the "Parameters" tab.

### 1.5.3.15. Printings

*ProSim DAC* offers various options for the printing of the calculation results. The parameters used in this example are listed in the table below.

| Parameters | Value |
|---|---|
| Print result files | Frequency = 10 s |
| Print outlet stream with time step of the module | Yes |
| Printing of input data | Yes |
| Type of results | Molar |
| Other parameters | Default value |

The screenshot below shows their specification in the "Parameters" tab, "Impressions" sub-tab.

### 1.5.3.16. Parameters

*ProSim DAC* provides an access to a given number of numerical and models parameters. The model is based on time integration and spatial discretization. The column is here discretized into 15 cells in order to obtain a "fine" solution of the problem.

| Model parameters | Value |
|---|---|
| Number of discretization cells | 15 |
| Solid transfer during regeneration | Given |
| Mass transfer coefficients of solid phase<br>    Air<br>    Carbon dioxide<br>    Water | 0 s$^{-1}$<br>0.0002 s$^{-1}$<br>0.002 s$^{-1}$ |
| **Other parameters** | |
| Default value | |

The screenshot below shows their specifications in the "Parameters" tab, "Parameters" sub-tab.

# 2. RESULTS

## 2.1. Adsorption column simulation report

The adsorption column simulation report ("Report") presents overall results (integrated over time), initial characteristics of the column, amount adsorbed, amount recovered during regeneration, etc.

The mass of adsorbent is not provided directly in the input data. It is calculated by *ProSim DAC* according to the geometric characteristics of the bed and the properties of the adsorbent. It is then interesting to check in the simulation report if the calculated mass of adsorbent corresponds to the one expected. For this example, the mass of adsorbent is just less than 3 g.

```
COLUMN GENERAL CHARACTERISTICS

Adsorbent mass in the column:   2.78410      (g)
Column volume            :     50.2655      (cm3)
Solid volume             :     45.6411      (cm3)
Void volume              :     4.62442      (cm3)
```

With the selected operating parameters (see § 1.5.3. among others), the adsorbent bed is 98% regenerated.

```
AMOUNT ADSORBED (mol)

These values include the inventory of the gas phase of the column.
```

| COMPONENT | Cycle N° 1 |
|---|---|
| AIR | 4.807498E-05 |
| CARBON DIOXIDE | 4.620825E-03 |
| WATER | 7.976939E-03 |

```
AMOUNT RECOVERED DURING THERMAL REGENERATION (mol)
```

| COMPONENT | Cycle N° 1 |
|---|---|
| AIR | 0.846638 |
| CARBON DIOXIDE | 4.543218E-03 |
| WATER | 7.733148E-03 |

## 2.2.  **Adsorption column profiles**

Several profiles in the adsorption column (temperatures, pressures, velocities, molar or mass concentrations, molar or mass fractions and breakthrough curves) are available at the end of the simulation in the editing window (tab "Profiles"). These profiles have two curves:

- ✓ "Fist cell":    Column inlet cell in the direction of adsorption flow
- ✓ "Last cell":    Column output cell in the direction of adsorption flow

If conter-current regeneration occurs:

- ✓ "First cell":   Column outlet cell
- ✓ "Last cell":    Column inlet cell

The figure below shows the time evolution of the temperature of the gas at the outlet of the column. A comparison with the results of [BAL24] is made for the adsorption step (the curves published by [BAL24] use a different type of regeneration than the one of this simulation). When the simulation starts, the temperature drops rapidly from the initial temperature of 120°C to the wall temperature specified for this step (20°C). Taking into account the thermal wall intertia would induce a less abrupt profile at the beginning of the adsorption step and corresponding to this of [BAL24]. As the pressure regeneration step is very short (80 s), it is almost invisible on this profile. During the temperature regeneration step, the temperature rise is gradual with the hot inert supply (120°C).



Gas temperature profile at the column outlet
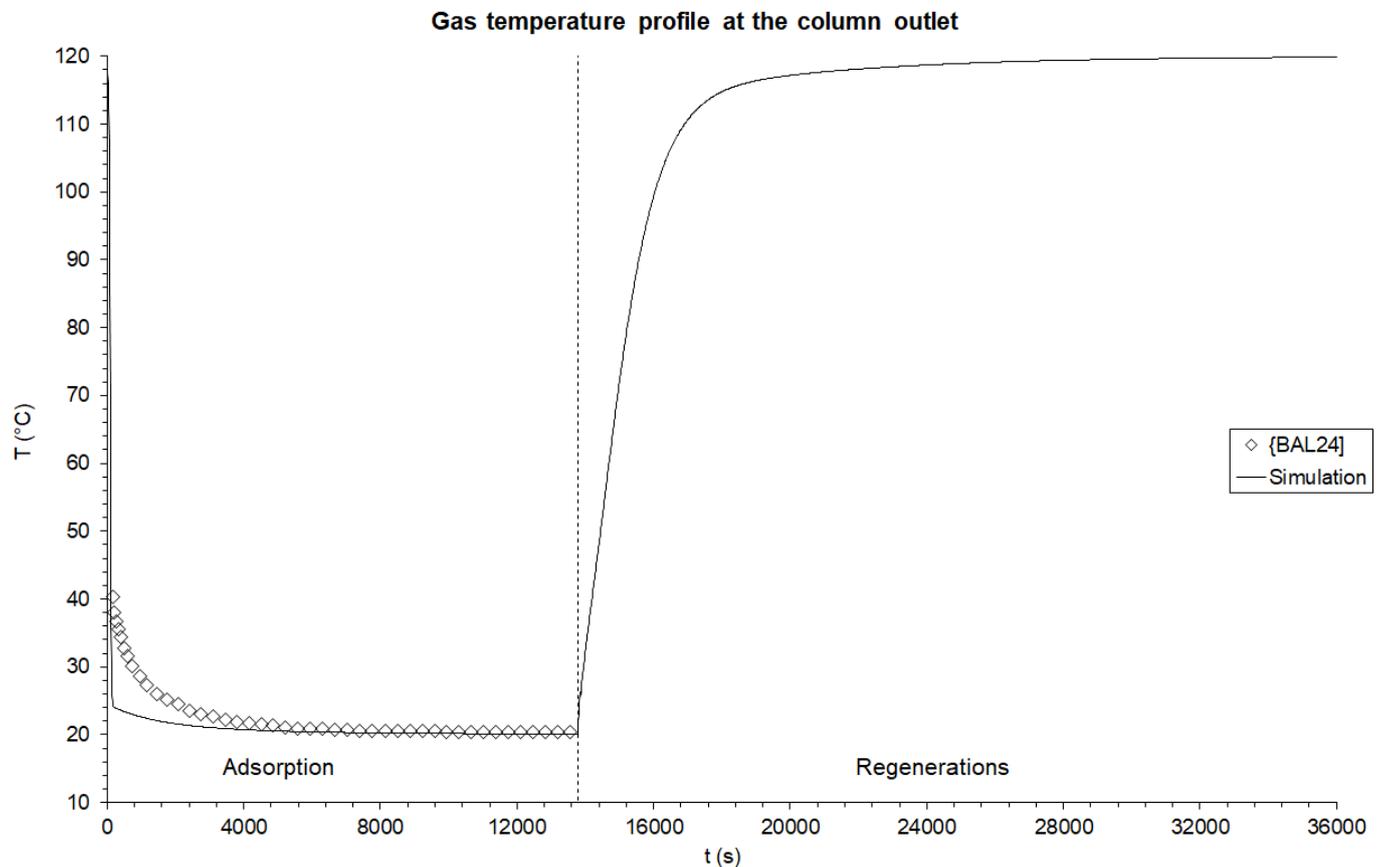
The figure below shows the time evolution of the adsorbed quantity of CO$_2$ at the outlet of the column. CO$_2$ adsorbs regularly during the adsorption step. A comparison with the results of [BAL24] is made for the adsorption step (the curves published by [BAL24] use a different type of regeneration than the one of this simulation). This step is stopped when the saturation of the bed with CO$_2$ is almost reached. The short pressure regeneration results in a peak in CO$_2$ adsorption. The bed is gradually regenerated during temperature regeneration. The simulation is stopped when the bed is almost completely regenerated.
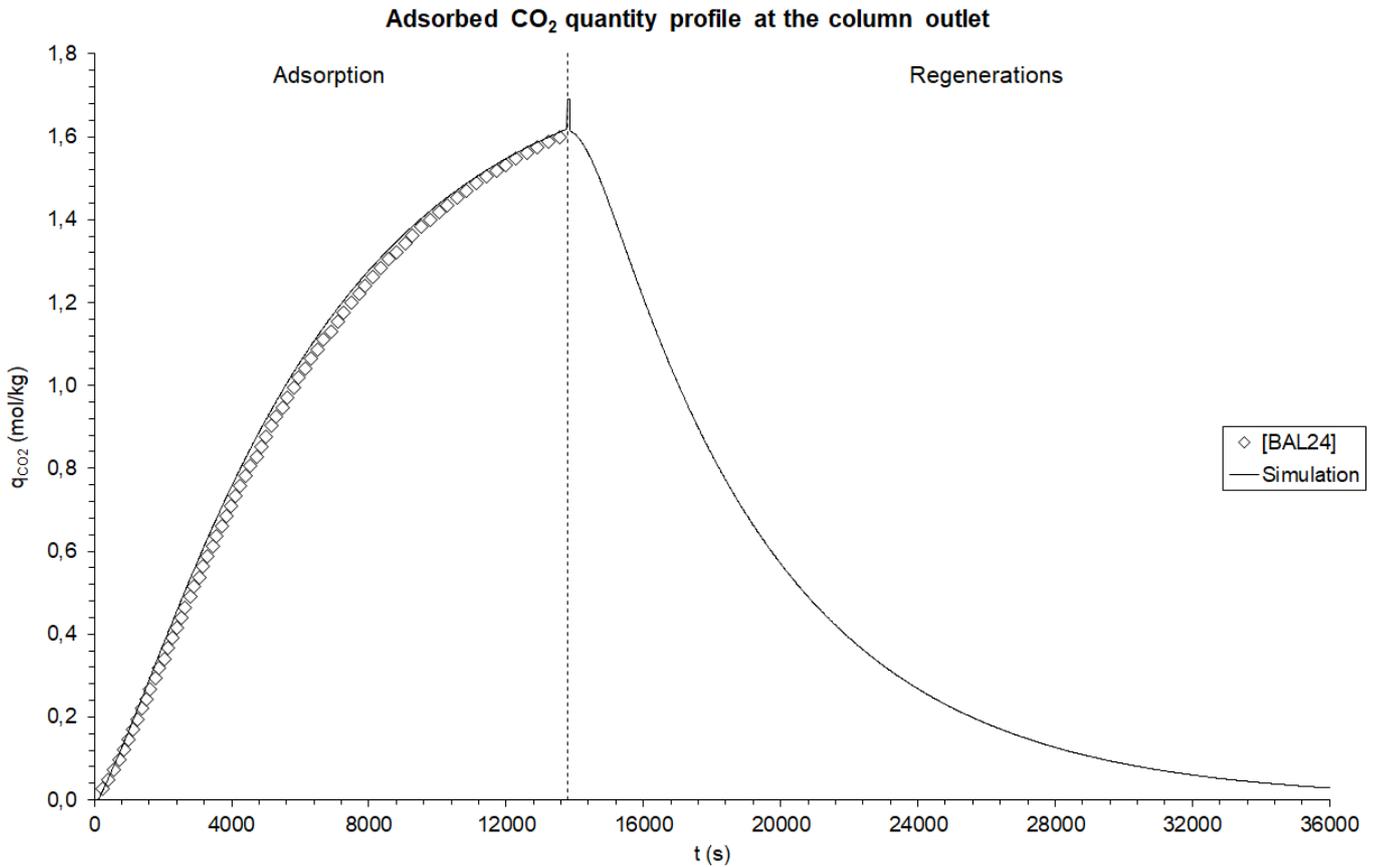
The figure below shows the time evolution of the adsorbed quantity of water at the outlet of the column. Water adsorbs regularly during the adsorption step. A comparison with the results of [BAL24] is made for the adsorption step (the curves published by [BAL24] use a different type of regeneration than the one of this simulation). At the end of this step, the bed is saturated with water. The short regeneration in pressure results in a peak in water adsorption. During temperature regeneration, the bed regenerates quickly. At the end of this step, the adsorbent is dry.
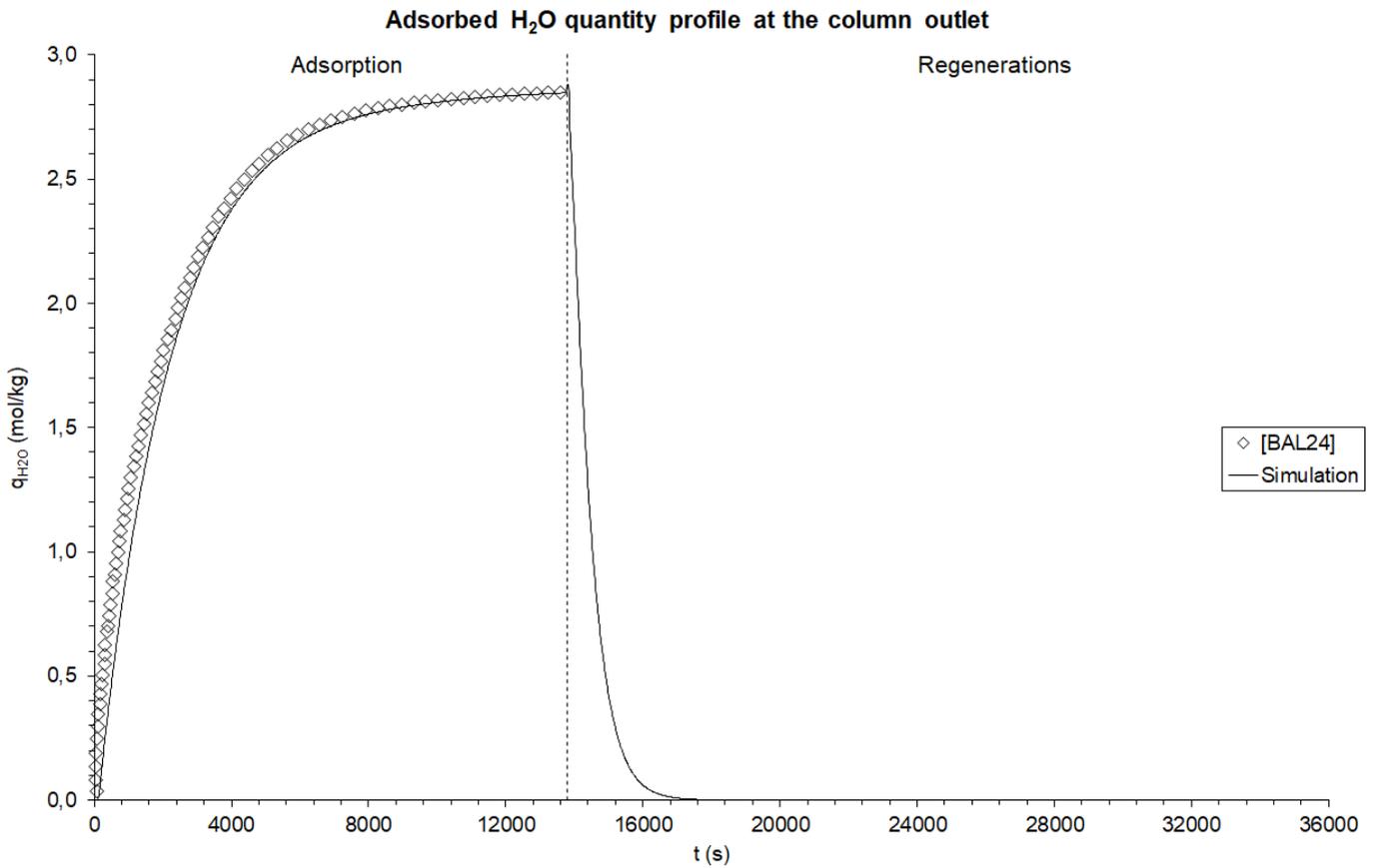
## 2.3.  **Outlet streams profiles**

Temperature, pressure, flow, enthalpy and composition profiles are also available for each adsorption column output streams at the end of the simulation. They can be accessed via the "Tabulated results..." button on the " Parameters" tab of the output stream editing window.
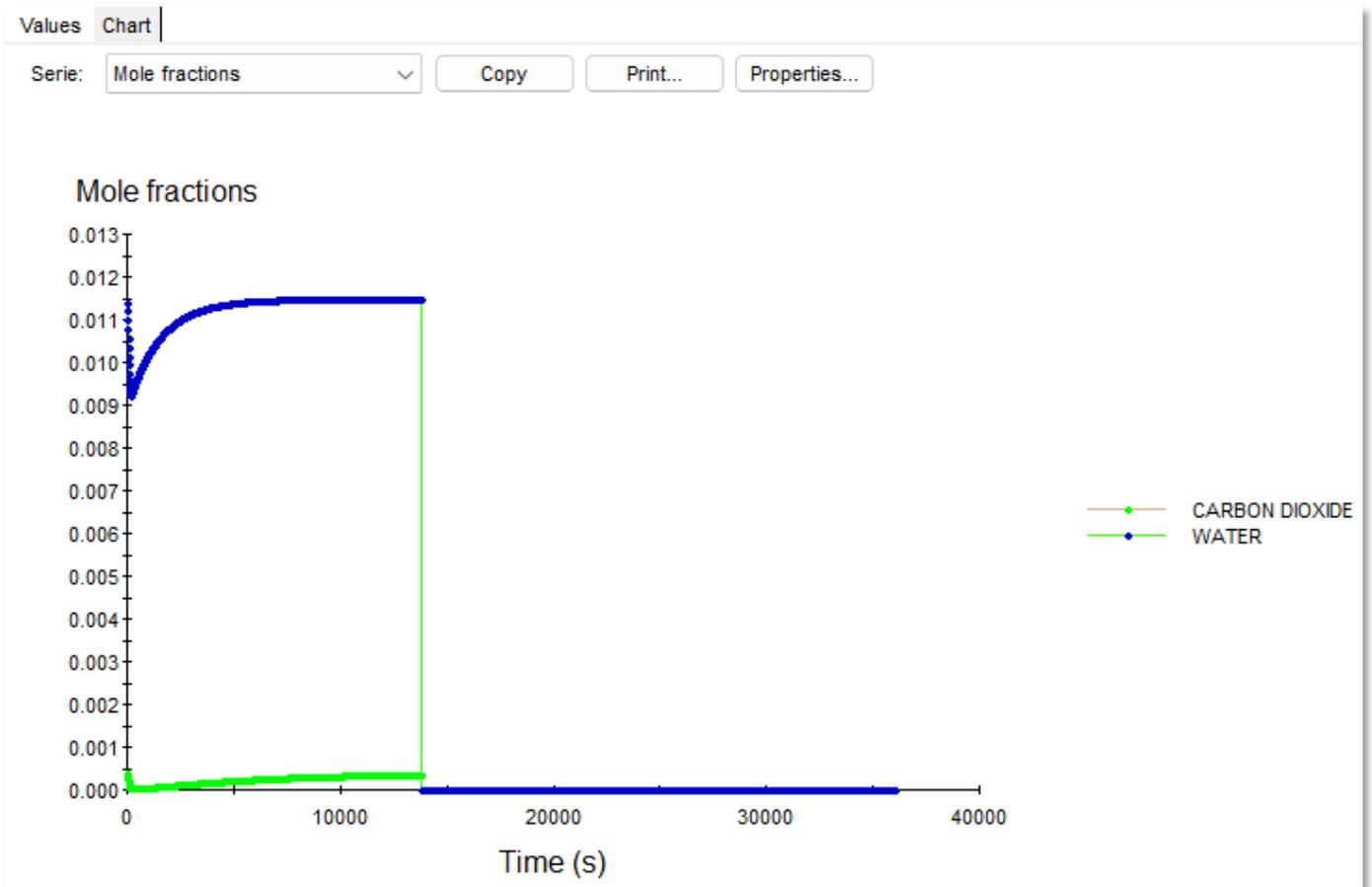
# 3. BIBLIOGRAPHY

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