

A CAPE-OPEN compliant simulation module

Notice

MEMSIC is a useful CAPE-OPEN compliant simulation software to simulate gas separation processes through a membrane module. This software has been developed at the Separation Processes Group (Laboratoire Réactions et Génie des Procédés, UMR CNRS 7274 – Nancy, France). Most process simulation software tools (PSE: Process Simulation Environment as ASPEN®, HYSYS®, PRO/II ®, PROSIM®, etc.) implement CAPE-OPEN interfaces that enables the end-user to plug CAPE-OPEN compliant tools and to export CAPE-OPEN compliant components.

Four different types of hydrodynamic conditions are taken into account in MEMSIC: (1) cross plug flow, (2) perfect mixing, (3) Co-Current plug flow and (4) Counter-Current plug flow. Additionally, five different concepts and/or theoretical model are proposed to describe the transport mechanism of molecular species through a membrane: (1) Constant Permeability, (2) Dual Mode, (3) Henry, (4) ENSIC and (5) Flory-Huggins.

Installation of the CAPE-OPEN module

In order to install the module, we have developed a wizard. By clicking on the setup assistant and after accepted the license agreement, the installation goes through a series of dialog boxes. Don't forget to plug the dongle into your computer before install the program.

IIII MEMSIC Setup	IIII MEMSIC Setup	
License Agreement Please review the license terms before installing MEMSIC.	Installation Complete Setup was completed successfully.	
Press Page Down to see the rest of the agreement. MEMSIC License Agreement This is an agreement between Licensor and Licensee, who is being licensed to use the MEMSIC Software. Licensee adxnowledges that this is only a non-exclusive, non-transferable license. Licensor is and remains the owner of all titles, rights, and interests in the Software. This Licensee permits Licensee to install the Software on more than one computer system, as long as the Software will not be used on more than one computer system could be obtained use copies of the Software on allow copies of the Software to be made by others, unless authorized by this License Agreement, Licensee Exercise regimes the Defense to be before one and the Software on and the Software one of the Software to be made by others, unless authorized by this License Agreement, Licensee	Completed Show details	
If you accept the terms of the agreement, click I Agree to continue. You must accept the agreement to install MEMSIC.		
MEMSIC CAPE-OPEN Unit Operation 4.0.0.1	MEMSIC CAPE-OPEN Unit Operation 4.0.0.1	Close Cancel

Implementation of the module in AspenPlus®

Four steps are needed:

- 1. Click "Customize" on the menu bar
- 2. Click "Manage Librairies" on the toolbars
- 3. Activate the "CAPE-OPEN" module
- 4. Close the window

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	Built-In			Vie	:w {	uilt-In	\sim		-
		CAPE-OPEN	View.		ew E	uilt-In	3)		
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ds Separators	User Models	CAPE-OPEN	
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Then, after these steps, a new model library appears at the bottom: "CAPE-OPEN". Use this new model library to select the unit operation model MEMSIC and place it on the flowsheet.

Implementation of the module in PRO/II®

Three steps are needed:

- 1. Click "Miscellanous" on the menu bar
- 2. Clik on the "CAPE-OPEN" icon
- 3. Select the MEMSIC module

Then, drag and drop the icon on the flowsheet.



PROII/CAPE-OPEN
Available CAPE-OPEN Unit operations:
Memsic_CO.UnitOperation.1
3 OK Cancel
Select a CAPE-OPEN Unit operation

Utilization of MEMSIC

Whatever the PSE, you have to follow these required steps:

- 1. Select the components to be used in your model
- 2. Set the calculation methods for physical and thermodynamical properties
- 3. Create your flowsheet by adding object: unit operation, streamline, compressor, etc.

When you connect a material stream with the module MESIC, in new windows appears in order to select if the stream has to be considered as the retentate side or the permeate side



- 4. Specify Material Streams to fully define both the stream's composition and its thermodynamic state: pressure, mole fraction, flow rate, etc.
- 5. When you double click on the MEMSIC module, a new windows opens with 6 different items: "General", "Compounds, Overview, Graph, Table, Reports

IIII MEMSIC Membrane M	odule						
General Compounds C	Overview Graph Table Reports						
Name							
Description	MEMSIC multicomponent gas separation membrane separator, by LF	RGP/Nancy (France)					
Flux model	•						
Flow pattern	Flow pattern Counter-Current						
Surface area	Surface area 500						
Downstream pressure	Downstream pressure 1.01325						
Membrane thickness	1	µm 💌					
	Copy Copy All X To Excel						
		00044					
For support please conta	For support please contact roda bounaceur@univ-lorraine.fr						
 Specification comple 	te 🗸 OK	X Cancel					

6. "General": enter the operating parameters, the surface area, the thickness, the flux model and the flow pattern

IIII MEMSIC Membrane M	lodule) [IIII MEMSIC Membrane M	lodule
General Compounds 0	Overview Graph Table Reports		General Compounds (Overview Graph Table Reports
Name	B1		Name	B1
Description	MEMSIC multicomponent gas separation membrane separator, by LRGP/Nancy (France)		Description	MEMSIC multicomponent gas separation membrane separator, by LRGP/Nancy (France)
Flux model	Constant Permeability		Flux model	Constant Permeability
Flow pattern	Constant Perneability Dual Mode		Flow pattern	Counter-Current
Surface area	Henry Ensic		Surface area	RPC RPA
Downstream pressure	I.01325 bar		Downstream pressure	Co-Current Counter-Current
Membrane thickness	1 µm 💌		Membrane thickness	1 🖉
	Copy ① Copy All 🔀 To Excel			다 Copy 다 Copy All 🕅 To Excel
	10066 ¹²			10066
For support please conta	act roda bounaceur@univ-lorraine.fr MEMSIC		For support please cont	act roda bounaceur@univ-lorraine.fr MEMSIC
✓ Specification comple	te VK Cancel		 Specification completion 	ete V OK X Cancel

7. "Compound": depending on the flux model, enter the different necessary parameters

100	MEMSIC Membrane N	Nodule				liii	MEMSIC Membrane I	Module				l	- 0 ×
	General Compounds	Overview Graph	Table Reports				General Compounds	Overview 0	Graph Tab	le Reports			
		Permeability						DDi	DHi	K	Ch	b	
	•	Barrer 📃 💌					•	cm²/s 💌	cm²/s ▼	cm³(STP)/cm³/atm	cm ³ (STP)/cm ³	▼ 1/atm	-
	Methane	1					Methane	_					
	Ethane	40					Ethane	_					
	Propane	6.66					Propane						
		Export					🖾 Import	Export	t Le				
	 Specification complexity 	ete		🗸 ОК	× Cancel	6	🔥 Unspecified DDi for	r compound N	lethane		🗸 ОК	>	Cancel
l				·									

(Constant permeability)

(Dual Mode)

8. "Overview"/"Graph"/"Table"/"Reports": when the calculation is finished, this tab give an overview of the results



"Overview"

"Graph"

Area	Retentate Flow	Retentate Methane	Retentate Ethane	Retentate Propane	Permeate Flow	Permeate N 🔺	Report: Last Run	
n²	mol/s	mol/mol	mol/mol	mol/mol	mol/s	mol/mol	Gelevistics stantals May Dug 10 11:45:15 2016	_
E-05	10	0.645	0.345	0.01	3.104E-08	0.06193	Calculation started: Mon Apr 16 11:45:15 2010	
.25	9.996	0.6452	0.3448	0.01	0.003878	0.06196		
.5	9.992	0.6455	0.3445	0.01	0.007752	0.062	Methane Permeability 1.000000e+000 Barrer	
3.75	9.988	0.6457	0.3443	0.01	0.01162	0.06204	Ethane Permeability 4.000000e+001 Barrer	
5	9.985	0.6459	0.3441	0.01001	0.01549	0.06207	Propage Permeability 6 660000e+000 Barrer	
6.25	9.981	0.6461	0.3439	0.01001	0.01936	0.06211		
7.5	9.977	0.6464	0.3436	0.01001	0.02322	0.06215		
8.75	9.973	0.6466	0.3434	0.01001	0.02708	0.06218		
10	9.969	0.6468	0.3432	0.01001	0.03093	0.06222	!	
1.25	9.965	0.647	0.343	0.01001	0.03478	0.06225	I Module MEMSIC!	
12.5	9.961	0.6473	0.3427	0.01002	0.03863	0.06229	L Crogg Flow multigermogant	
3.75	9.958	0.6475	0.3425	0.01002	0.04248	0.06233	i Cross Flow multicomposant	
15	9.954	0.6477	0.3423	0.01002	0.04632	0.06236	! systeme dimensionnel!	
6.25	9.95	0.6479	0.342	0.01002	0.05016	0.0624	! Janvier 2015!	
17.5	9.946	0.6482	0.3418	0.01002	0.054	0.06244	I Roda bounaceur!	
8.75	9.942	0.6484	0.3416	0.01002	0.05783	0.06247	11	
20	9.938	0.6486	0.3414	0.01002	0.06166	0.06251	· · · · · ·	
21.25	9.935	0.6488	0.3411	0.01003	0.06549	0.06255		
22.5	9.931	0.6491	0.3409	0.01003	0.06931	0.06258 👻		
20 70	0.007		0.0107	0.04000	0.07040	A		
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Spec	ification complete	•		1	ОК	× Cancel	✓ Specification complete	🗙 Can

9. By clicking on the "To Excel" button, you store all the results in an excel file

III MEMSIC Membrane M	lodule				A1 •	fr Name				
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General Compounds (Overview Graph Table Reports			1 N	ame	81				
			1	2 D	escription	MEMSIC multicompone	ent gas separation me	mbrane separator,	by LRGP/Nancy (Fra	nce)
Name	B1			3 FI	ux model	Constant Permeability				
				4 FI	ow pattern	RPC				
Description	MEMSIC multicomponent gas separation membrane separato	r, by LRGP/Nancy (France)		5 54	artace area	500	m			
				0 0	pstream pressure	1 01113	bar			
Flux model	Constant Permeability	-			ownstream pressure	1.01543	o bar			
				0 H	emorane unickness		mol /s			
Flow pattern	Counter-Current	-		10	processi now rate		1110175			
				11		Permeability				
Surface area	500	m ² •		12		Barrer				
				13 M	lethane	1				
Downstream pressure	1.01325	bar 👻		14 0	thane	40)			
	,			15 Pt	ropane	6.66				
Membrane thickness	1	µm 💌		16						
	le . lle let			17 A	rea	Retentate Flow	Retentate Methane	Retentate Ethane	Retentate Propane	Perr
				18 m	8	mol/s	mol/mol	mol/mol	mol/mol	mol
				19	0.00001	9.999999965	0.645000002	0.344999998	0.0	4
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				21	2.50001	9.992247625	0.645452314	0.344544607	0.01000307	1
				22	3.75001	9.988376271	0.64567843	0.344316975	0.01000461	5 1
				23	5.00001	9.984508128	0.645904464	0.344089386	0.01000614	1
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r or support please conta	act roua.bounaceur@univ-tonaltie.ll	1.121.101.0		29	12.50001	9.961366655	0.64725993	0.342724765	0.01001530	5 (
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