MatLab Unit Operation potential improvements for academic use

Matlab™ into Aspen Plus™ case

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Presentation Overview

- Software solutions within a research project in University

- Overview of current thesis project

- Matlab Unit Operation (MUO) into Aspen: examples, limitations

- DAC-UNIT current errors - solutions

- MUO User friendly?

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Software solutions within a research project in academy

- Development of Mathematical Models, new ideas

- Freedom on choosing the simulation software

- Different software tools = different solution approaches

    - Equation oriented vs modular modeling

    - Steady vs dynamic

- Integration tools required e.g.: CAPE-OPEN Matlab Unit Operation

Thank you CO-LaN!
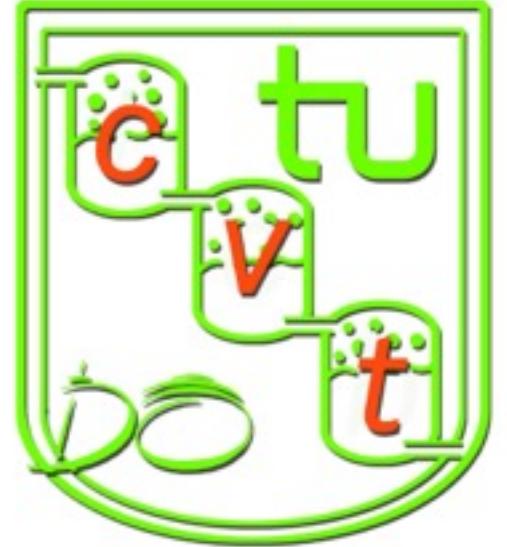
Overview of current thesis project

- General research project topic:

"Adsorptive Direct Air Capture of CO$_2$"

M.Sc. Carsten Drechsler, Prof. David W. Agar

- Thesis topic:

"Optimal cost-based design of a highly integrated thermally coupled DAC-PTG process"

- Among tasks: Existing Matlab (r2013b) rigorous model for the DAC unit should be implemented into Aspen Plus V8.8

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Matlab into Aspen Plus case

- CAPE-OPEN Matlab Unit Operation (MUO) Download and installation

Matlab CAPE-OPEN				
file	size	description	platform	last update
MatlabCapeOpenUnitOperation.2.0.0.9.exe	1400 KB	Matlab CAPE-OPEN Unit Operation Windows installer.	Windows, Matlab 7.7 (or higher)	28 aug 2018
MatlabCapeOpenThermoImport.2.0.0.5.exe	943 KB	Matlab CAPE-OPEN Thermo Import installation file.	Windows, Matlab 7.7 (or higher)	28 aug 2018

- First issue: Compatibility error - solution given by CO-LaN

    - More intuitive error message

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Use of the MUO into Aspen Plus V8.8

- Online help guide https://www.amsterchem.com/matlabunitop.html
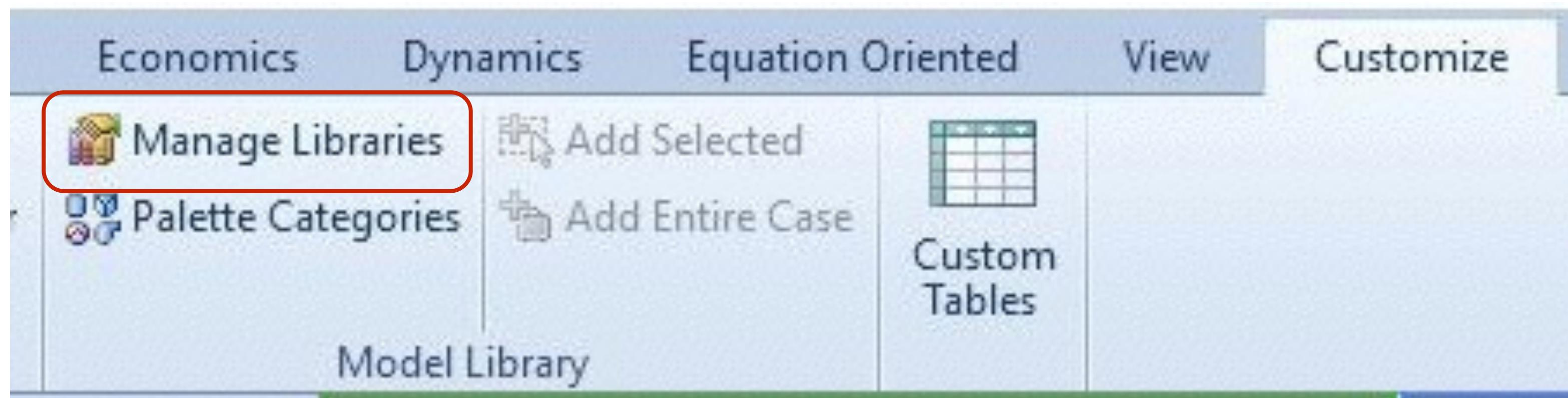
- CAPE-OPEN library in Aspen

Use of the MUO into Aspen Plus V8.8

- CAPE-OPEN library in Aspen
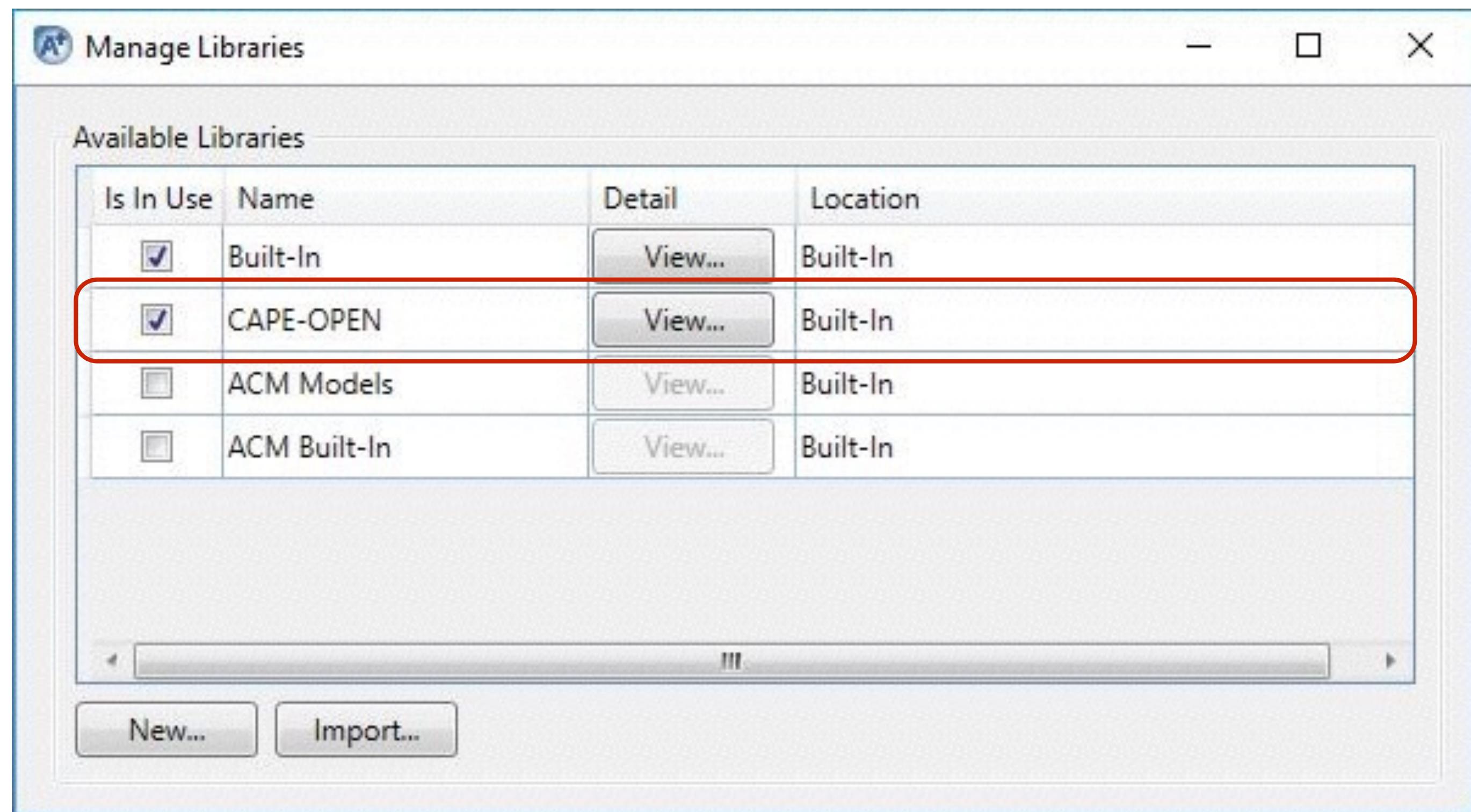
# Use of the MUO into Aspen Plus V8.8

- CAPE-OPEN library in Aspen
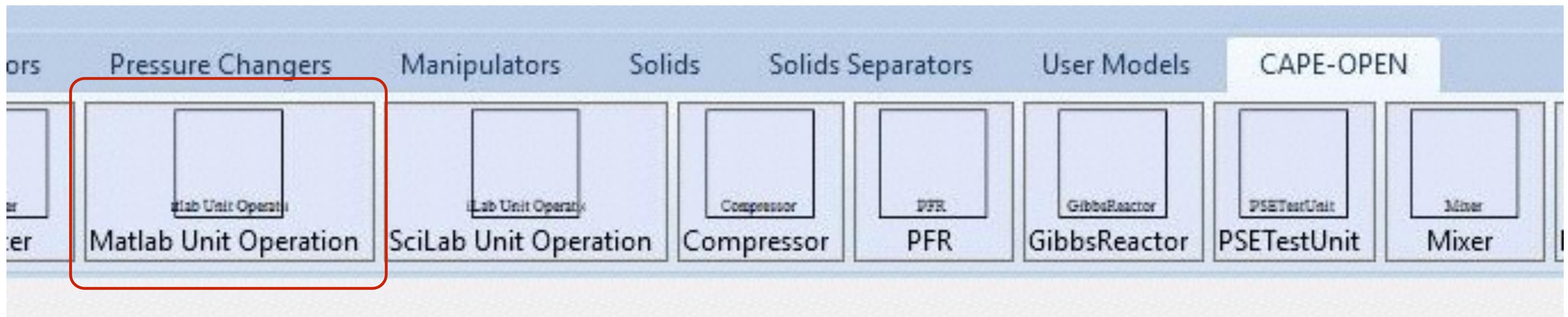
General Example

Matlab Unit Operation with 3 connected streams. No errors

MUO

Water / Ethanol mixture

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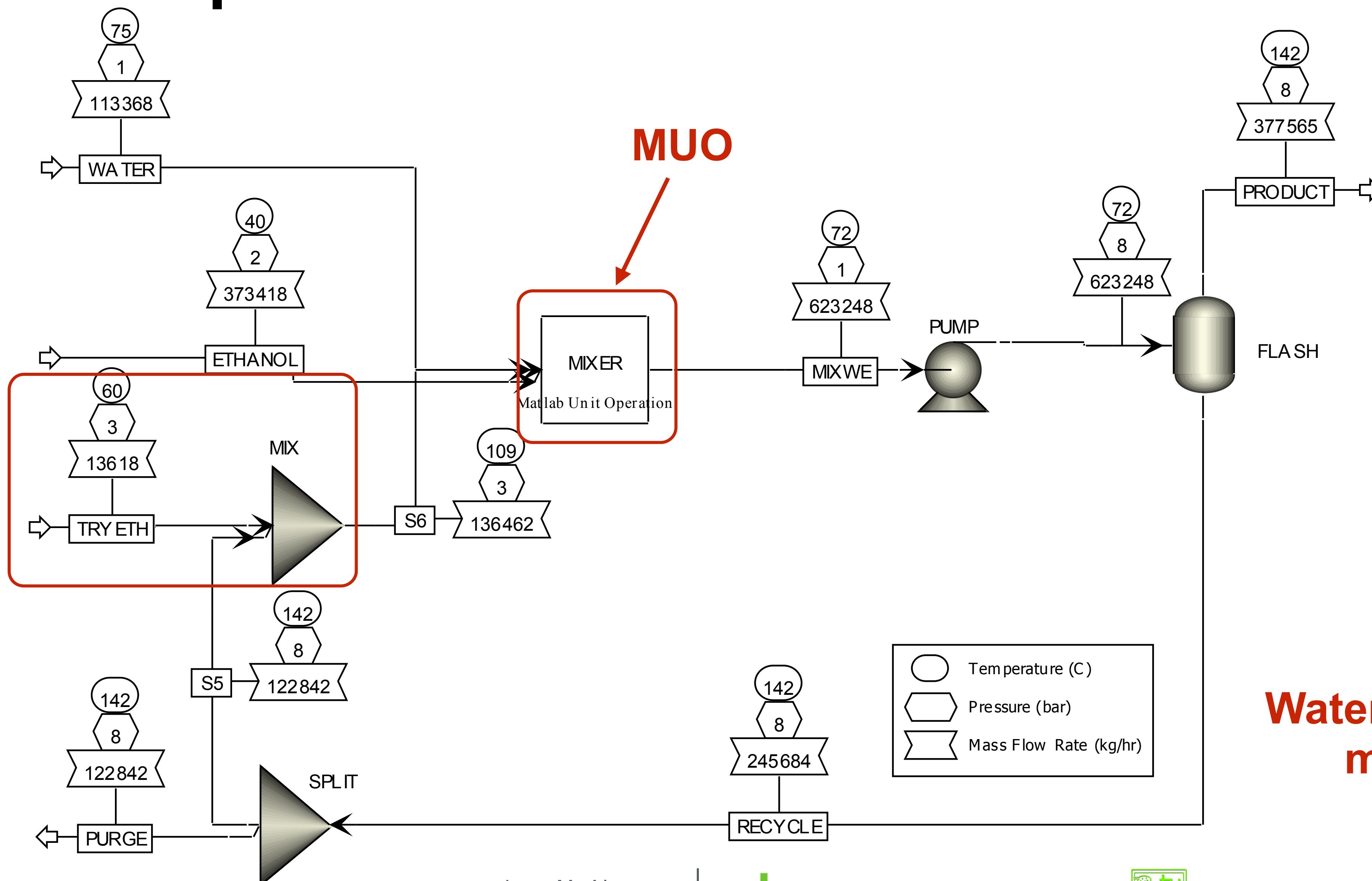
Recycle stream without direct declaration produces errors in the aspen simulation environment

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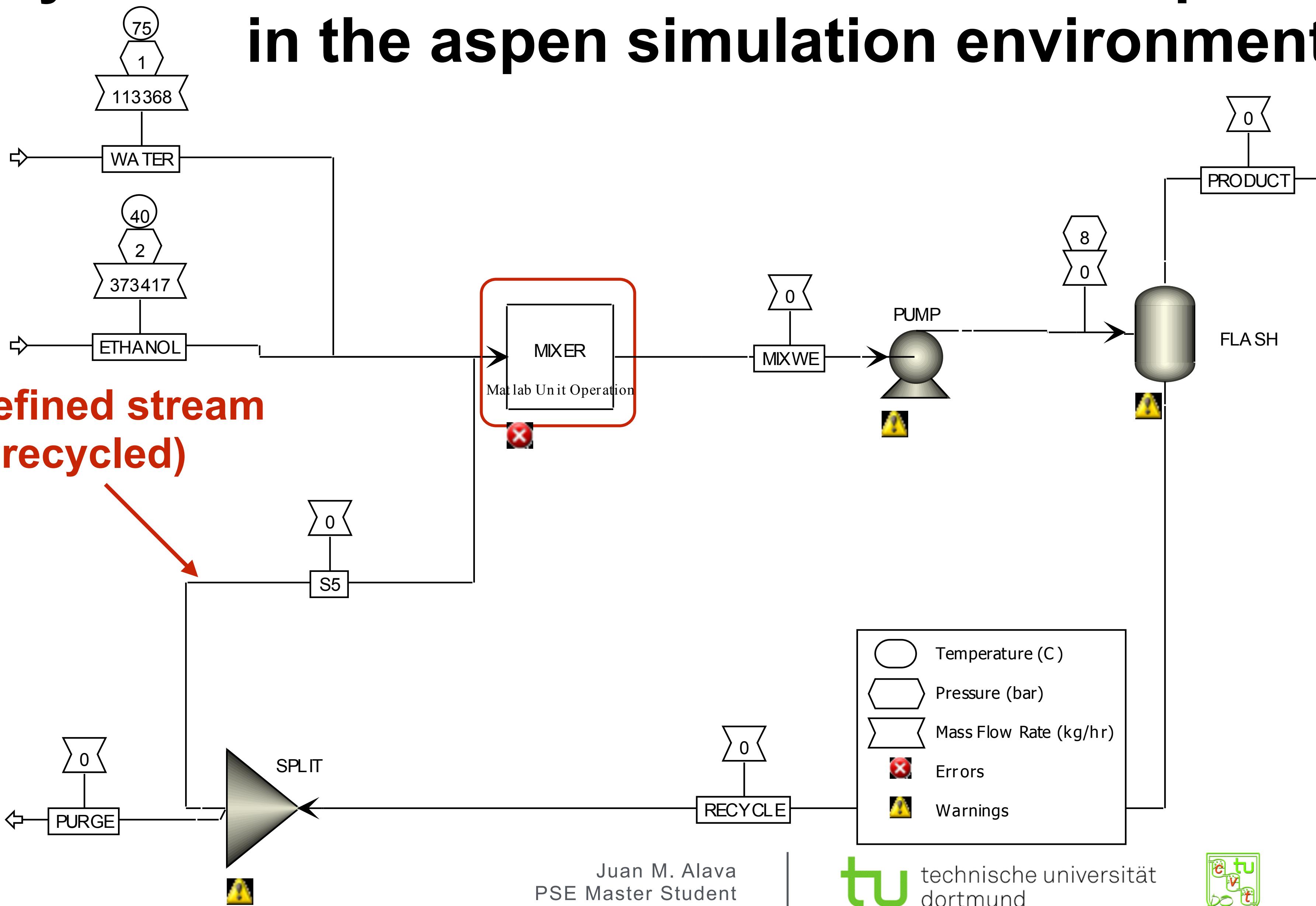
Recycle stream without direct settings produces errors in the Aspen simulation environment

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Use of a duplicated MUO with the same code (errors)

COFE flowsheet UO

Undefined input stream (recycled)
or
Multiple UO?

MUO

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Use of a duplicated MUO with the same code (errors)

MUO error

Same error

Use of a duplicated cape open Unit with different code (MUO error)

Connected MUOs

Undefined input stream? (recycled)

Temperature (C)

Pressure (bar)

Mass Flow Rate (kg/hr)

Errors

Warnings

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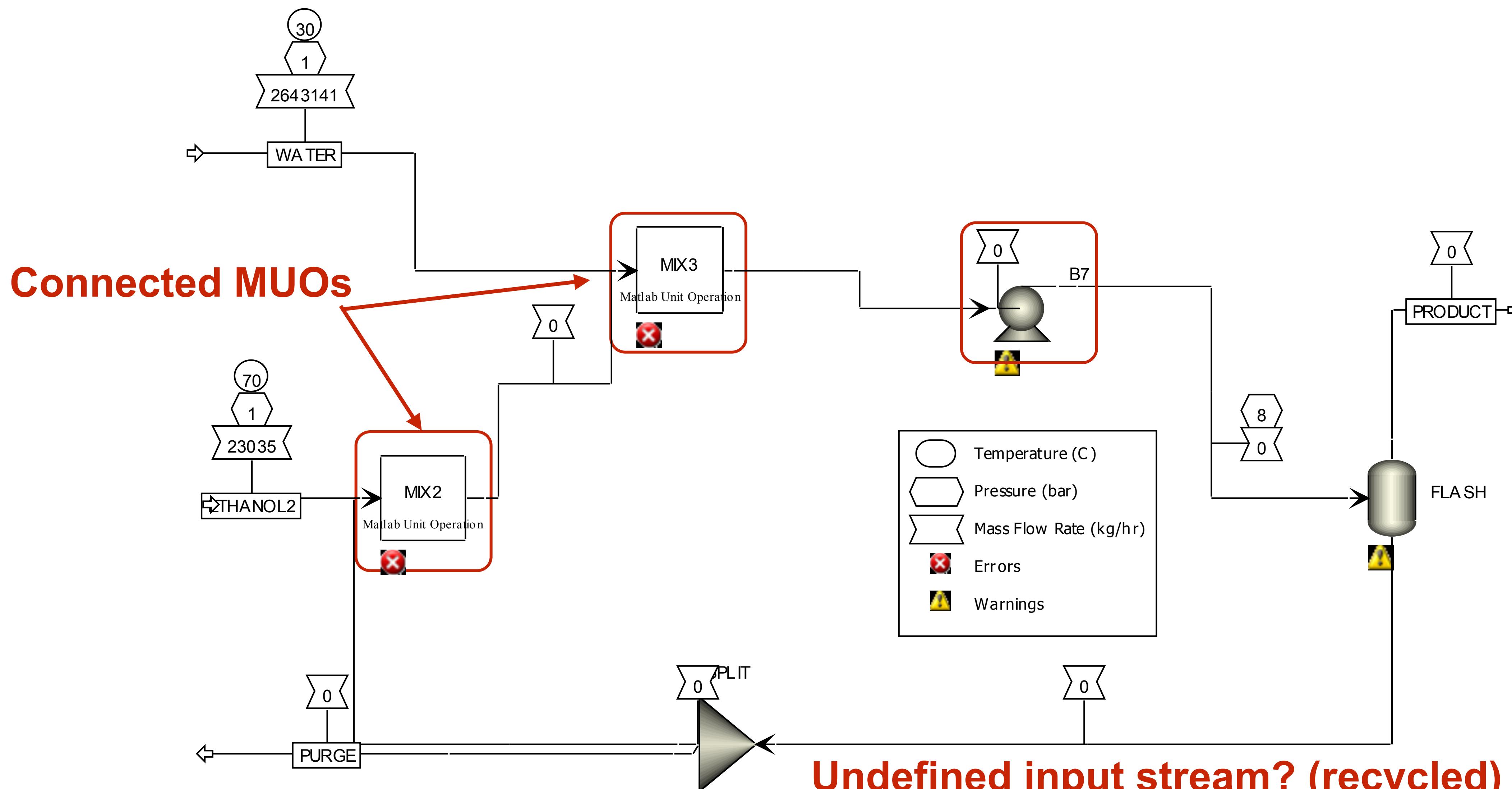
Use of a duplicated MUO with the same code (no error)

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Behaviour of the MUO (DAC-UNIT) in Aspen

Power To Gas concept

CO_2

DAC-UNIT

Matlab code

H_2

Methanation Sabatier Reactor

Methane

Unreacted Components

Aspen Simulation Environment

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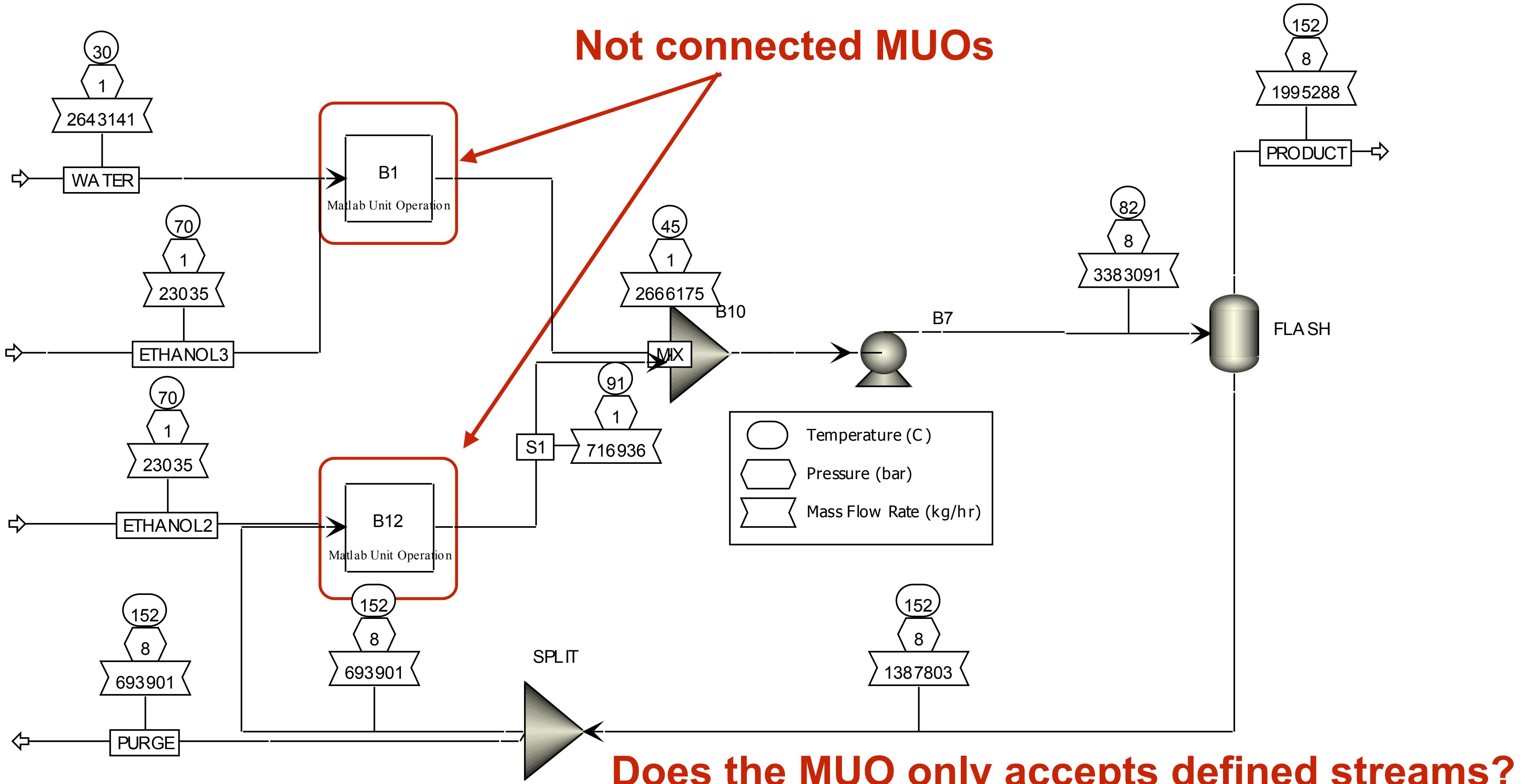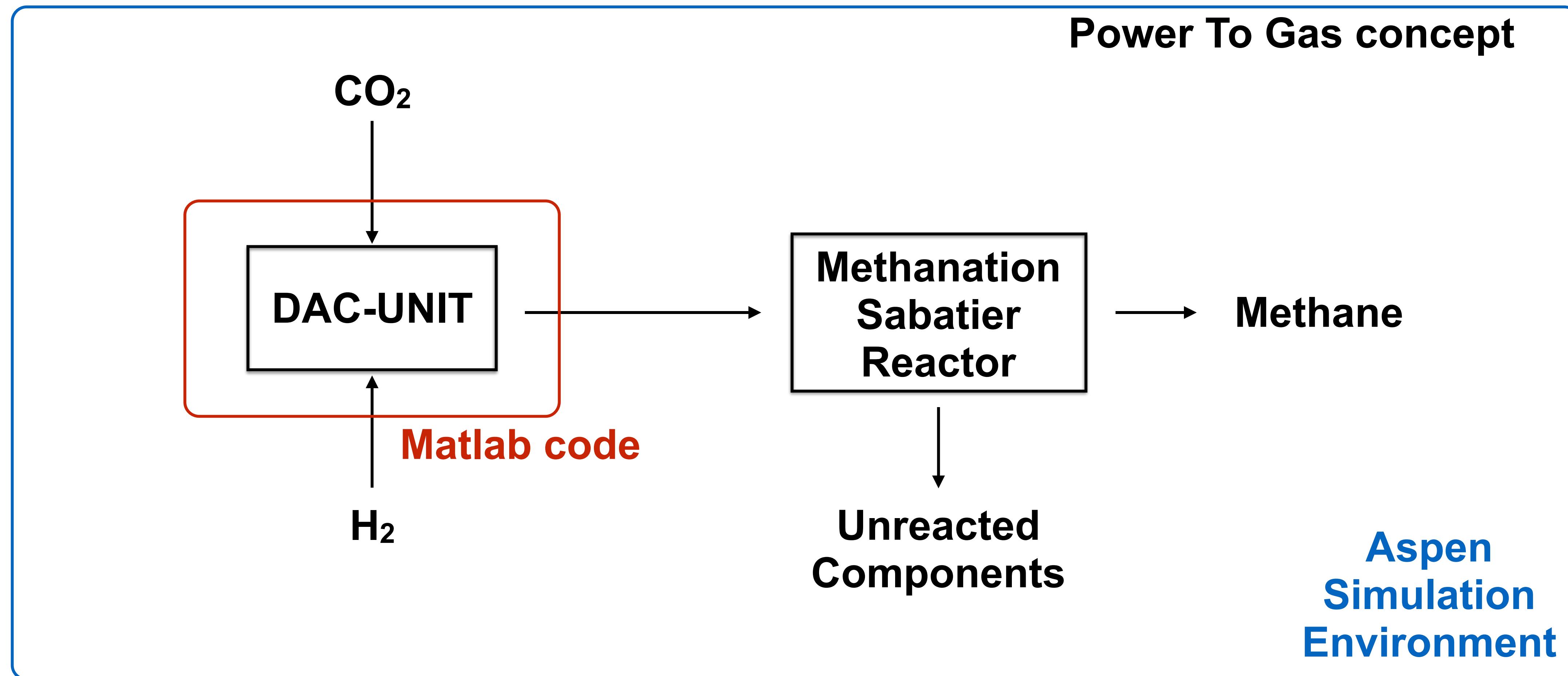
Behaviour of the MUO (DAC-UNIT) in Aspen
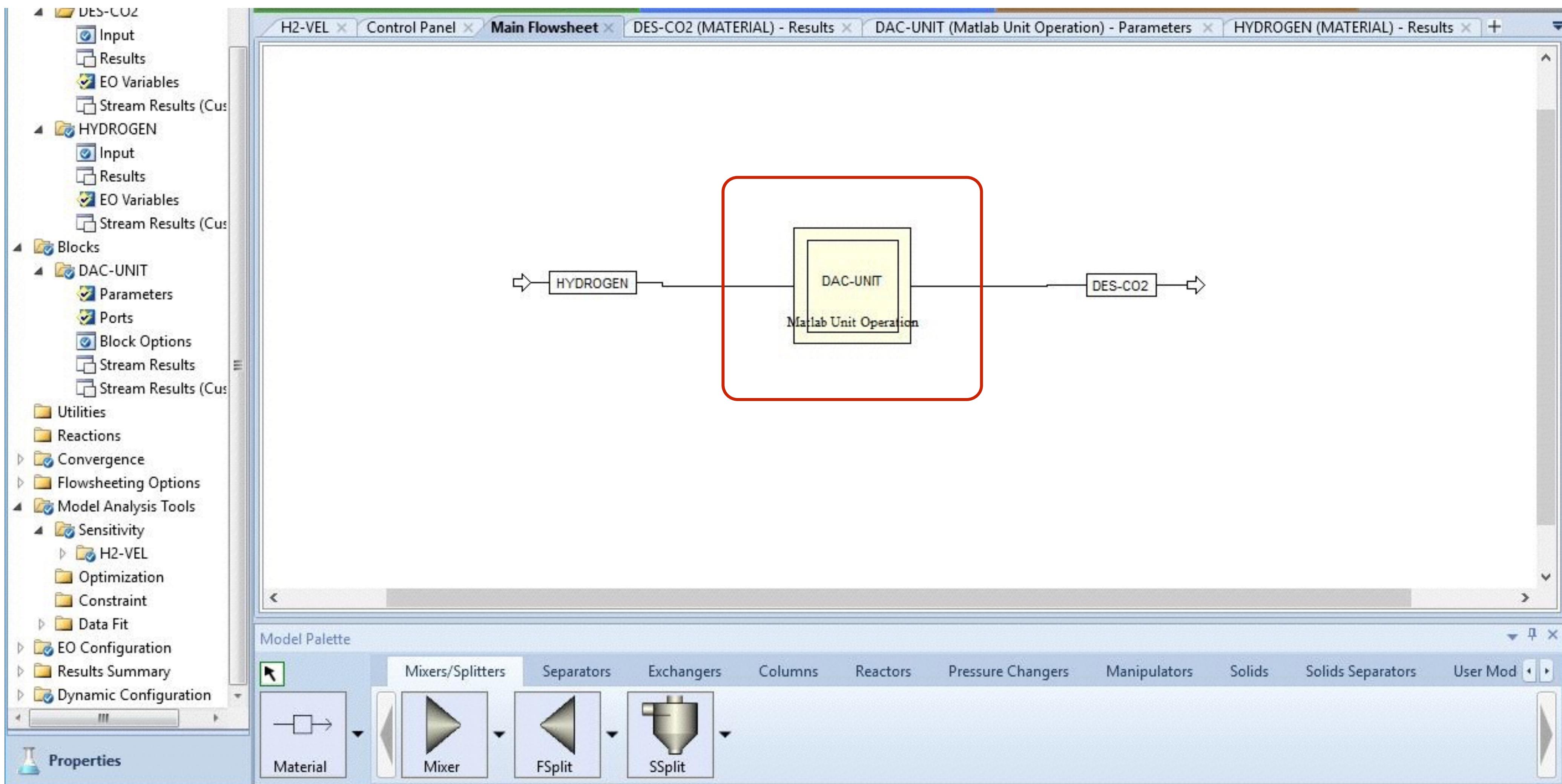
Input specification of the DAC-UNIT in Aspen

- 9 input parameters need to be specified

- So far 7 output parameters and states are obtained from the DAC-UNIT for analysis:

  - Sensitivity analysis

  - Optimisation studies (costs)

  - Design specification

Presented error of the DAC-UNIT in Aspen

- When a simulation error is present the simulation engine stops working

- The streams are disconnected and MUO won't work
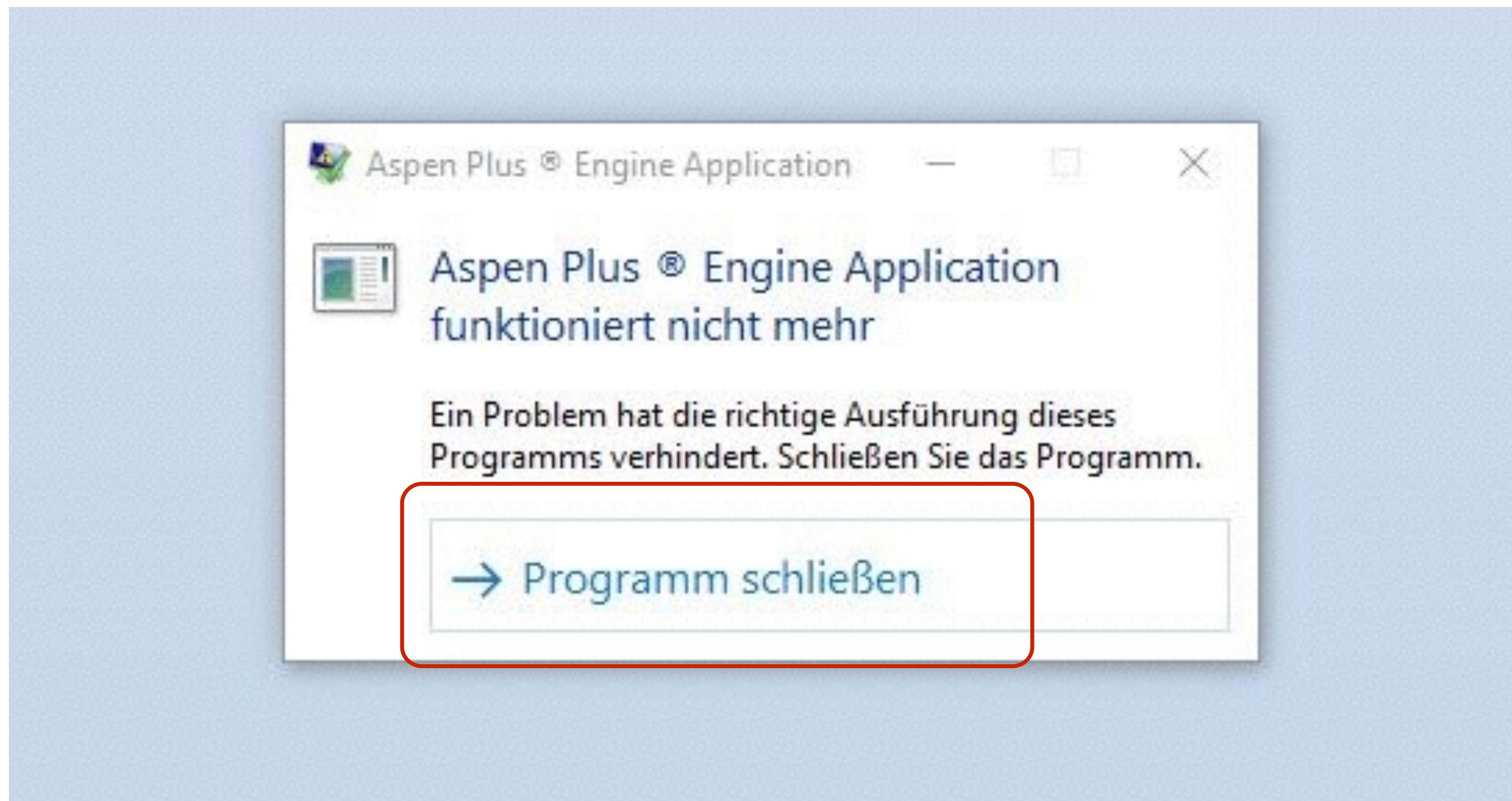
Presented error of the DAC-UNIT in Aspen

- Solution: let the Aspen simulation environment restart.
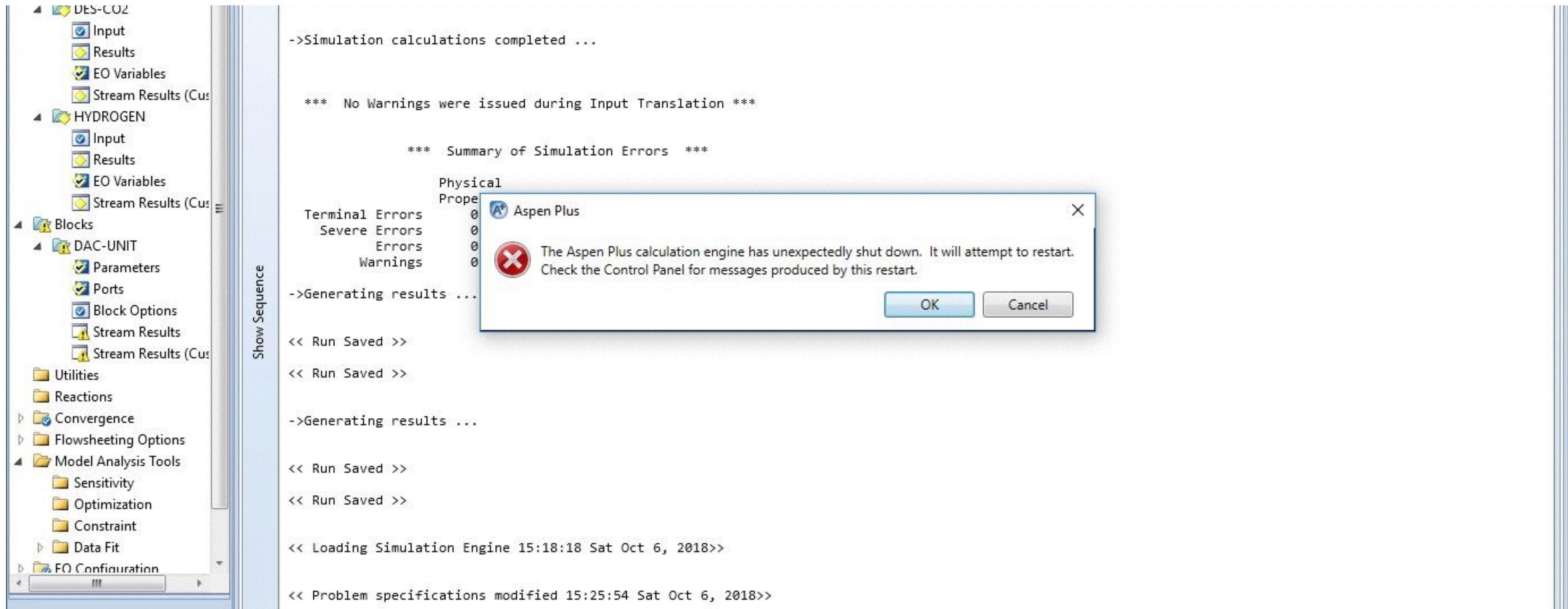
Presented error of the DAC-UNIT in Aspen

- Solution: let the Aspen simulation environment restart

- Disconnect the input / output streams

- Reset the simulation (reset button)

- Edit the MUO by loading the .mum file for the DAC-Unit

- Reconnect the streams

- Run the simulation

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Current diagnostic and solution by CO-LaN

- Use the COLTT application to understand the source of the problem

    - COLTT 2.4.0 Controller x64

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General Improvements on MUO

- Include a default port to be declared after the stream connection.

- Allow copy and paste of parameters in the parameter declaration tab.

- Allow several Matlab file scripts to be selected and incorporated in the additional files tab.

- Current online help content related to the MUO should be integrated into the MUO dialog window.

- Improvement on working with recycle streams (undefined stream).

- Improvement on Aspen to MUO communication.

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Thanks for your attention