



Global CAPE-OPEN

Open Simulation Demonstration in HYSYS and Aspen Plus

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Scope

- **Interoperability of Open Software Components in Commercial Simulator Executives**
 - ⇒ **Aspen Plus**
 - ⇒ **HYSYS.Process**
- **“Clean Build” BP PC**
 - ⇒ **No fixes**
- **CAPE-OPEN Interfaces for:**
 - ⇒ **Unit Operations**
 - ⇒ **Thermodynamics**

Initial Build

- **Aspen Plus 10.2-1 / AspenProperties 10.2-1**
 - ⇒ **Service Pack 1 or Update 1**
 - ⇒ **Plus CAPE-OPEN Hotfix**
- **HYSYS.Process 2.2 Build 3797**
 - ⇒ **Plus HYSYS.CAPE-OPEN 1.03, Build 235 / 236 / 237**
- **HyproTech CAPE-OPEN updates available to GCO members via ftp**
 - ⇒ **www.hyprotech.com/cape-open**
- **Windows NT 4.0 Service Pack 5 or higher**
- **Internet Explorer 4.01 Service Pack 2 or higher**
 - ⇒ **May not be significant**

The Flowsheet

➤ HDA (Hydrodealkylation) Model

- Industrially significant
- Multiple distillation columns
- Multiple recycles
- Warning - Exhibits retrograde condensation
 - Some flash calculations (including TP and PV) can have multiple solutions!

➤ Implemented in:

- HYSYS.Process
- Aspen Plus

➤ Note that the implementations are not completely identical!

Unit Operations - Overview

➤ Demonstrate interoperability of CAPE-OPEN Unit Operations

⇒ Two different CAPE-OPEN Unit Operations in a single flowsheet

⇒ In both AspenPlus and HYSYS.Process

➤ Unit Operations used are “Mixer-Splitters”

⇒ Relatively simple and easy to specify

⇒ But

- Require internal streams
- Need an internal flash and hence use thermodynamics

Unit Operations

- **Open Mixer-Splitter (M-S) Software Components**
 - ⇒ **Produced by Hyprotech and AspenTech**
 - ⇒ **Independent of any commercial software packages**
 - **But AspenTech M-S delivered with AspenPlus**

- **Each Component can provide Persistence by either:**
 - ⇒ **CAPE-OPEN methods**
 - ⇒ **COM methods**

- **Hyprotech Component has both:**
 - ⇒ **Install**
 - ⇒ **De-install**

Unit Operations Demonstration (1)

- **Install the Hyprotech M-S component**
 - ⇒ **Note the de-install capability**
- **Open the HYSYS.Process HDA flowsheet**
- **HYSYS.Process Solution**
 - ⇒ **Mix out' 61.09 °C**
 - ⇒ **Mix out 53.17 °C**
- **Add Hyprotech M-S**
- **HYSYS.Process uses COM persistence**
 - ⇒ **Issue - COM vs CORBA?**



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Unit Operations Demonstration (2)

- **AspenTech M-S component already installed with AspenPlus**
- **Add AspenTech M-S to Previous Flowsheet**
 - ⇒ **Both CAPE-OPEN components now included**
- **Differences in Reporting**
 - ⇒ **Hyprotech M-S has worksheet feature**
 - ⇒ **AspenTech M-S has a different approach**
 - ⇒ **Example of CAPE-OPEN standards, not standardisation**



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Unit Operations Demonstration (3)

- **Open the AspenPlus HDA flowsheet**
- **AspenPlus solution**
 - ⇒ **Outlet M1B 101.2617 °F**
 - ⇒ **Outlet M1 116.6252 °F**
- **Add both Hyprotech and AspenTech M-S components**
- **Convergence within Tolerance**
- **Persistence in Aspen Plus**
 - ⇒ **Issue - rounding on parameter values?**



HDAap_Demo.bkp



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Thermodynamics - Overview

- **Demonstrate the ability to add CAPE-OPEN Property Packages to a flowsheet**
 - ⇒ **In addition to “native” thermodynamics**
 - ⇒ **In both AspenPlus and HYSYS.Process**
- **Property Packages can be created:**
 - ⇒ **From a Property System**
 - E.g. AspenProperties
 - ⇒ **As a standalone Property Package**
- **Need to take care over basis used for enthalpies / entropies**
 - ⇒ **Hysys and AspenPlus calculate different entropy values**

Thermodynamics Demonstration - Aspen Plus

- **CAPE-OPEN Property Packages (PP 's)**
 - ⇒ **Create from Aspen Plus HDA simulation**
 - Example of creating a Property Package from a Property System
 - Issue - de-install process needed
 - ⇒ **Install Hyprotech HDA Example Standalone PP**
- **Use AspenProperties PP for M1A in AspenPlus HDA simulation**
 - ⇒ **Issue - no PP identification in standard yet**
 - ⇒ **Only 1 CO PP in Aspen Plus at present**
 - ⇒ **Text file is used to store information about CO PP**
- **Use Hyprotech Example Standalone PP for whole flowsheet**
 - ⇒ **Cooler V12 modelled as two UO's to avoid incorrect solution**
 - ⇒ **Issue - computation speed**



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Thermodynamics Demonstration - HYSYS

- Use AspenProperties PP for CO subflowsheet in HYSYS HDA simulation
 - ⇒ Original outlet temperature 36.80 °C
 - ⇒ Replace AspenProperties PP with Hyprotech Example Standalone PP
- Use the AspenProperties PP for Full Flowsheet, but:
 - ⇒ Hyprotech Example Standalone PP for CO subflowsheet
 - ⇒ HYSYS native thermodynamics for the column subflowsheets
- AspenProperties PP for Full Flowsheet
 - ⇒ Issue - computation speed



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Proof of Thermodynamic Interoperability

- **Simple Flash in Aspen Plus**
 - ⇒ **Ethanol/water 50% vaporised**
- **Stream Results:**
 - ⇒ **Vapour phase = 30.68431 kmol/h ethanol**
 - ⇒ **Temperature = 80.31637 °C**
- **Export the Aspen CAPE-OPEN Property Package**
- **Solve the Same Flash using HYSYS**
- **Repeat using the AspenTech CAPE-OPEN Property Package**



Eth_wat.hsc



Eth_wat.bkp



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De-installation of CAPE-OPEN Components

- **De-install the Hyprotech Mixer-Splitter**
- **Reload HDA Flowsheet in HYSYS**
- **Reload HDA Flowsheet in Aspen Plus**
- **Informative Reporting in Both Cases**

Summary

- **Practical Interoperability Achieved in Steady-State, Sequential Modular Simulation**
 - ⇒ **Unit operations**
 - ⇒ **Regular fluid thermodynamics**
- **Demonstrated in Commercial Versions of HYSYS.Process and Aspen Plus**
- **Technical Issues Remain, but no Show Stoppers**