EHM105 - Unlock Operational Excellence with AI-Powered Digital Twins

Course Agenda

Aspen HYSYS Process Simulation Overview

- Identify the benefits of process simulation
- Describe the capabilities of Aspen HYSYS
- Introduce the Aspen HYSYS graphical user interface and organizational structure

Getting Started

- Enter necessary elements to fully define a Fluid Package
- Specify required parameters in order to execute flash calculations and fully define material streams
- Modify and set desired units of measure
- Review stream analysis options and Emissions Manager to perform emissions calculations
- ***Workshop****: Introduce basic concepts necessary for creating simulations in Aspen HYSYS*

Propane Refrigeration Loop

- Add and connect unit operations to build a flowsheet
- Use available tools to manipulate the user interface
- View and customize the Aspen HYSYS Workbook
- Convert a simulation case to a template
- ***Workshop:*** *Build and analyze a propane refrigeration loop*

Reporting in Aspen HYSYS

- Survey common result reporting techniques in Aspen HYSYS
- Generate Excel reports from the HYSYS Workbook
- Use the Report Manager to create custom unit operation and stream reports
- Identify steps to perform CO2 emissions tracking, Carbon Fee, Utility Consumption and Cost calculations - *Sustainability Focus*
- Discover how to report non-standard physical properties in your material streams
- Introduce Data Tables as an option to create customized simulation results tables
- Provide a brief introduction to Aspen Simulation Workbook, enabling integration between Microsoft Excel and Aspen HYSYS

Oil Characterization and HP Separation

- Introduce the Aspen HYSYS Oil Manager and Assay Management features and how they are used for assay characterization
- Perform Spreadsheet calculations in Aspen HYSYS
- Use the Case Study feature to run flowsheet-wide scenarios
- ***Workshop****: Use the Assay Management tools to characterize a crude assay, then employ the Spreadsheet and Case Study features to determine how Gas-Oil Ratio (GOR) varies with operating pressure*

Heat Exchanger Rating

- Review the available heat transfer unit operations in Aspen HYSYS
- Compare and contrast the applicability and operation of different heat exchanger models
- Learn how to assign process utilities to energy streams to see usage at stream level
- Implement Aspen Exchanger Design & Rating (EDR) for rigorous heat exchanger calculations within Aspen HYSYS
- Introduce the Activated Exchanger Analysis feature for continuous heat exchanger study and design
- ***Workshop:*** *design and rate a heat exchanger using the EDR interface inside Aspen HYSYS*

Gas Gathering and Crude Pre-Heat Train

- Use the Pipe Segment operation to model single and multi-phase fluid flow
- Introduce Pipe Segment Flow Assurance capabilities to ensure short and long-term viability of pipelines
- Introduce mathematical operations, starting with the Balance and Adjust
- Introduce the Recycle operation in Aspen HYSYS
- ***Workshop Gas Gathering (O&G Focus):*** *Use the Pipe Segment and its built-in Flow Assurance tools to model and study a piping network in Aspen HYSYS*

-Or-

- ***Workshop Crude Pre-Heat Train (Refinery Focus):*** *Using a variety of heat transfer, separations, and piping unit operations, construct a raw crude pre-heat train flowsheet*

NGL Fractionation and Atmospheric Crude Column

- Introduce Aspen HYSYS column models and templates
- Use the Input Expert to add and define a distillation column
- Add and manipulate column specifications to meet process objectives
- Include column side operations for additional distillation configuration options
- ***Workshop NGL Fractionation (O&G Focus)****: Model a two column natural gas liquids (NGL) fractionation train*

-Or-

- ***Workshop Atmospheric Crude Column (Refinery Focus)****: Construct, run, manipulate, and analyze an atmospheric crude distillation column*

Introduction to Aspen Hybrid Models

- Understand what Aspen Hybrid Models are
- Review different types of modeling approaches and their advantages and disadvantages
- Recognize the importance of using hybrid modeling and how it can help solve complex problems

Creating Aspen Hybrid Models

- Review overall approach to building Aspen Hybrid Models
- Identify tools needed to create Aspen Hybrid Models
- Discuss how to login to Aspen AI Model Builder
- Understand how to deploy Aspen Hybrid Models in Aspen Plus/Aspen HYSYS

Workflow for Creating an AI Model Builder Project

- Understand the workflow of AI Model Builder
- Create a new project
- ***Workshop:*** *Create a project in AIMB to generate a Hybrid Model*

Data Importing and Configuration

- Learn the way to import the data
- Set up the data for hybrid model development
- ***Workshop:*** *Import and configure the data to generate a hybrid model*

Workflow for Data Cleaning

- Get familiar with the type of data sets
- Identify the cleaning methods

Build the Project

- Recognize the key steps in building the hybrid model
- ***Workshop:*** *Build the hybrid model using AI Model Builder*

Analyze and Deploy

- Analyze results for the model built
- Use deployment tool to add a hybrid model in a simulator program
- ***Workshop:*** *Analyze and deploy the hybrid model*

Introduction to Aspen Multi-Case

- Review what is Aspen Multi-Case
- Discuss the advantages of using Aspen Multi-Case
- Demonstrate steps involved in using Aspen Multi-Case
- ***Workshop:*** *Generate simulation data using Aspen Multi-Case*
- ***Workshop:*** *Deploy a hybrid model using simulation data*

Overview Of Plant Data Feature

- Overview of "digital twin" concept
- Review the workflow of Plant Data in simulator
- ***Workshop***: *Import Raw Plant Data from Excel*
- ***Workshop***: *Condition the Collected Plant Data*
- ***Workshop***: *Link Model Input Variables to Plant Data Sources*
- ***Workshop***: *Run the Model Using the Conditioned Data*
- ***Workshop***: *Link Model Results to Output Tags*
- ***Workshop***: *Publish to Aspen OnLine (AOL)*

Solution architecture and Success stories of Digital Twin (AI and Online)
Identify and discuss use cases and deployment strategies

Optional Exercises and Extra Materials (Time Permitting)

Best Practices & Troubleshooting Hysys flowsheet

- Discover Activated Analysis for continuous evaluation of economics, energy usage, equipment design, and dynamic modeling
- Recognize how "Pinch technology" is used to minimize energy use and optimize heat exchangers - *Sustainability Focus*
- Identify best practices for using Aspen HYSYS
- Investigate reasons why a simulation may produce poor results or errors
- Use suggested tips to debug a variety of simulations
- ***Workshop****: Troubleshoot a series of Aspen HYSYS simulations and implement various best practices to get these simulations to solve properly*

Acid Gas Package in Hysys

- Introduce the Acid Gas Property Package
- Carbon capture and storage example of carbon capture using DEPG (physical solvents) and MEA (chemical solvents) - *Sustainability Focus*
- Dynamic modeling capabilities for Acid Gas Columns in v12 - *Sustainability focus*
- ***Workshop:*** *Model an acid gas sweetening process using diethanolamine*

Liquefied Natural Gas (LNG) Plant build in Hysys

- Use the LNG Exchanger operation to simulate multi-pass heat exchangers
- Utilize the Sub-Flowsheet to build a modularized process flowsheet
- ***Workshop:*** *Model an LNG production process*