Flowmaster
Fluid thinking for systems engineers

Power Generation

Cummins Inc.

Linking Flowmaster with Microsoft Excel : Powerful Tool for GUI Automation and Design Optimisation

World Class Mechanical Engineering

Global power company Cummins Inc. has been a thriving Flowmaster customer since 2002. Since then, Cummins has had repeated successes in modelling both cooling and lubrication systems. A great portion of these analyses has been performed by Cummins Research and Technology India Limited (CRTI). Located in Pune, India, CRTI provides world class mechanical engineering design and analysis for Cummins worldwide.

Creative Implementation of Flowmaster

Mr Malapure, a Flowmaster user, creatively implements Flowmaster to its design and analysis process.

CRTI supports all Cummins Business Units (Engine, Power Generation and Components (including Turbo Technologies, Emission Solutions, Fuel Systems, Filtration, etc.)) as well as Cummins Joint Ventures. Among the multiple projects in this area, one stands out above the others, as Vinod Malapure, a Flowmaster user at CRTI, creatively implements Flowmaster to its design and analysis process. Understanding Flowmaster's capability to link with external software, Mr. Malapure takes advantage of his knowledge and expertise on Microsoft Excel to co-simulate with Flowmaster.

System engineers can easily change the input data and view results in a single page

Full Capability for non-Flowmaster Users

The goal is to create a system where a non-Flowmaster user can use the Flowmaster solver without the need of having to personally manipulate the Flowmaster GUI. The MS Excel representation of the Flowmaster CHP (Combined Heat and Power) plant model will allow the system engineers to easily change the input data and view the results in a single page.

Power Plant Cogeneration

A power plant rejects a large amount of heat to the ambient, which can be recovered and used for other applications. If the amount of heat recovered from engines and/or other heat sources can be estimated, then this energy in turn can be used for cogeneration or simply for heating a building.

Modelling Using Heat Exchanger Components

Mr. Malapure was trained on the basics and functions of Flowmaster. With this knowledge, he was able to build Flowmaster models for heat transfer and flow analysis of CHP.

HT Loop (Engine)

ID/Component	Input Variable	Quantity	Unit
HX1	Loss Coefficient (Optional)		
	Pipe Area (Cross Sectional)		
	Engine Heat Rejection		
Valve 1	Diameter		
	Valve opening (Controlled by Thermostat)		
HX2	Loss Coefficient 1		
	Pipe Area 1 (Cross Sectional)		
	Loss Coefficient 2		
	pipe Area 2 (Cross Sectional)		
	Effectiveness		
HX3	Loss Coefficient 1		
	Pipe Area 1 (Cross Sectional)		
	loss Coefficient 2		
	pipe Area 2 (Cross Sectional)		
	Thermal Effectiveness		
Pump	Rated Flow		
	Rated Head		
	Rated Speed		
	Rated Power		
	Initial Speed		
Flow Source 1	Liquid/Gas Type		
	Flow Rate		
	Temperature		
Pressure Source1	Liquid/Gas Type		
	Total/Static Pressure		
	Temperature		
Thermostat Hysteresis	Operating Curve(Temp Vs Valve Opening)		

LT Loop (C.A.C. & L.O.)

ID/Component	Input Variable	Quantity	Unit
HX3	Loss Coefficient (Optional)		
	Pipe Area (Cross Sectional)		
	CAC & LO Heat Rejection		
Valve 2	Diameter		
	(Controlled by Thermostat)		
HX4	Loss Coefficient 1		
	Pipe Area 1 (Cross Sectional)		
	Loss Coefficient 2		
	pipe Area 2 (Cross Sectional)		
	Thermal Effectiveness		
HX5	Loss Coefficient 1		
	Pipe Area 1 (Cross Sectional)		
	loss Coefficient 2		
	pipe Area 2 (Cross Sectional)		
	Thermal Effectiveness		
Pump	Rated Flow		
	Rated Head		
	Rated Speed		
	Rated Power		
	Initial Speed		
Flow Source 2	Liquid/Gas Type		
	Flow Rate		
	Temperature		
Pressure Source2	Liquid/Gas Type		
	Total/Static Pressure		
	Temperature		
Thermostat Hysteresis	Operating Curve(Temp Vs Valve Opening)		

Process Water Loop

ID/Component	Input Variable	Quantity	Unit
HX6	Loss Coefficient 1		
	Pipe Area 1 (Cross Sectional)		
	Loss Coefficient 2		
	pipe Area 2 (Cross Sectional)		
	Thermal Effectiveness		
HX7	Loss Coefficient 1		
	Pipe Area 1 (Cross Sectional)		
	Loss Coefficient 2		
	pipe Area 2 (Cross Sectional)		
	Thermal Effectiveness		
Genral Tabular (Used as a Pump)	Output Quantity		
	1st Time		
	Output Value (Flow rate)		
HX8	Loss Coefficient 1		
	Pipe Area 1 (Cross Sectional)		
	Loss Coefficient 2		
	pipe Area 2 (Cross Sectional)		
	Thermal Effectiveness		
Flow Source 3	Liquid/Gas Type		
	Flow Rate		
	Temperature		
	Density		
Pressure Source 3	Liquid/Gas Type		
	Total/Static Pressure		
Flow Source 4	Liquid/Gas Type		
	Flow Rate		
	Temperature		
	Density		

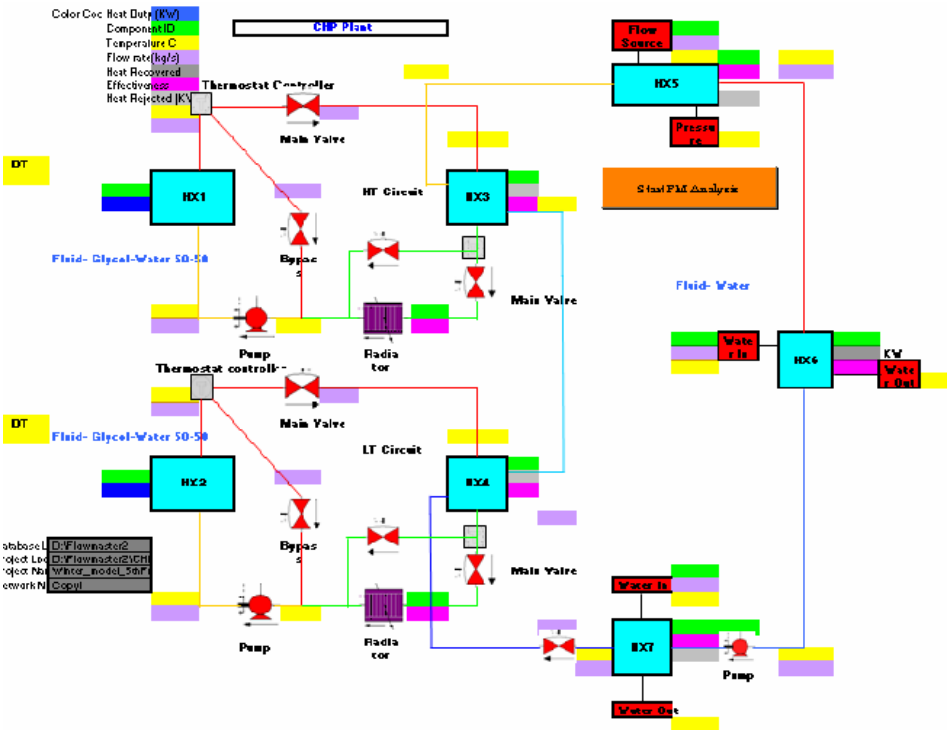
Co-simulation Analysis

Mr. Malapure created a similar model in an Excel sheet with coloured blocks and lines to represent the components and component connections as in Flowmaster. He designed the Excel sheet in a way where the user only has to change the independent design parameter within the given allowable range of values in its corresponding units. An internal code, written by Mr. Malapure, allows the user to execute a co-simulation analysis. By linking Flowmaster, the results are reported back to Excel, one sheet in SI units and another in English units.

Powerful Tool for the Engineering Team

GUI automation served as a powerful tool for the engineering team

This methodology has allowed Mr. Malapure and his team of system engineers to work under a non-Flowmaster user level GUI architecture with all Flowmaster capabilities and benefits; view different results, such as flow rate, pressure, temperature, etc, for each component in a single page; analyse and understand the flow diagram in a systematic level; and run multiple scenarios in a relatively short amount of time. Compared to having to perform calculations in a spreadsheet, and the time for a non-Flowmaster user having to learn and determine how to extract the results from Flowmaster, this GUI automation served as a powerful tool for the engineering team.



With the above system created and implemented within the analysis process, the engineering team seeks to calculate the maximum heat recovery from the system. Simultaneously, this tool will be used to select the correct heat exchanger that delivers maximum efficiency.