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University of Bahrain
College of Engineering
Department of Chemical Engineering

COMPUTER AIDED DESIGN TOOL FOR FIRED HEATERS

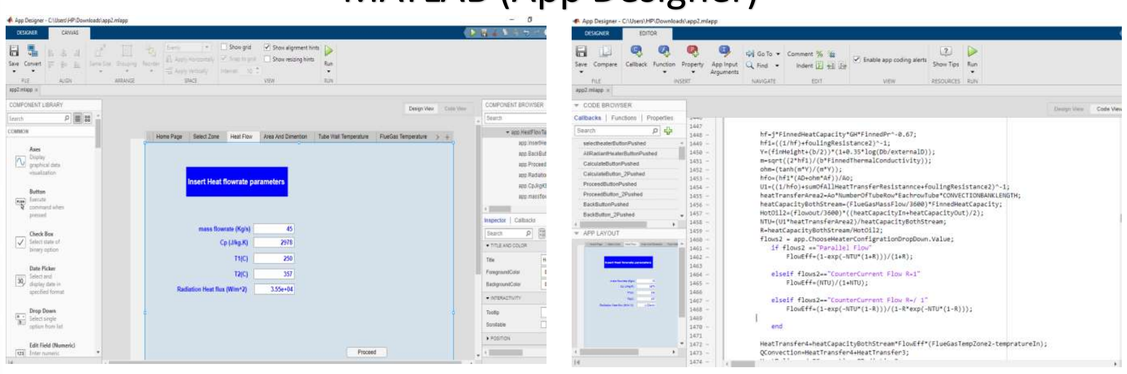
Abstract

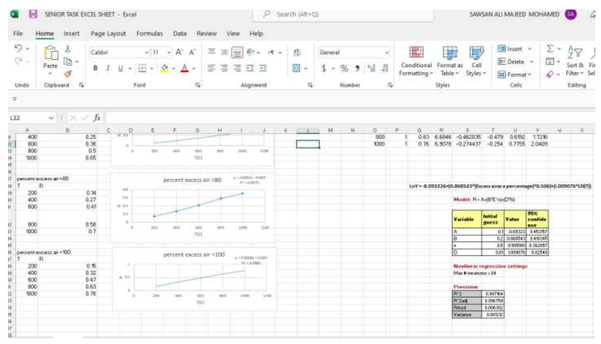
A fired heater is one of the essential equipment in a chemical plant. In this project, a MATLAB Graphical User Interface (GUI) was used to build a user-friendly software tool for developing and rating fired heaters. The software package, which consists of active windows, is used to analyze a fired heater's design, including rating type design. In a validity assessment, the developed tool was found to be in reasonable agreement with the literature. The software is friendly-user, reliable, and can be used to rate non-reactive furnace types.

Design and Implementation

The aided design tool is a MATLAB app designer, with the help of Excel and Polymath, which allows for easy application development. The app for designing and rating fired heaters included two types of heater: all-radiation heater box type and rating radiation-convection vertical type.

MATLAB (App Designer)





Excel

Conclusion

In this project, a MATLAB Graphical User Interface (GUI) was used to build a user-friendly software tool for acquiring and rating fired heaters. The obtained results of the software were compared with literature examples and showed excellent agreement for two different types of fired heaters. The software is a friendly user, reliable, and can be used to rate non-reactive furnace types. It can also be used for educational functions and in industrial sectors.

Objective and Motivation

Objective:

1) The software is designed to assist students in understanding the fired heater analysis concept, including the design/rating of system components for a certain application.

2) the program is intended to serve professionals to evaluate fired heaters in the chemical industry.

Motivation:

It is well known that design calculations of fired-heaters are open-ended type problems and require the application of a trial-and-error method. Although students are required to conduct the design calculation to understand the design principles, hand calculation is a tedious process, prone to error, and time-consuming. Self-learning plus the use of computers in design applications becomes part of our curriculum. These issues motivate us to develop a friendly user and reliable software that can be used to obtain reliable design results on time. The program can help students in their design courses.

Results

The performance of our software (ADRT) was tested by comparison with the results of the literature. This was included to assess the performance of the software. Two fired-heater types are tested: the All-Radiation Fired Heater Box Type and the Radiation-Convection Fired Heater One. It was demonstrated that excellent comparison results were obtained, which indicates the reliability of the software.

Variable	Book Result	ADRT Result	Percentage differences
All-Radiant Heater Results Box type			
Total heat flow (J/s)	**14339000**	**14339070**	**4.88e-4**
Total Area (m^2)	**402.1**	**402.1182**	**0.0182**
Q/W_f (J/kg)	**3.03E+07**	**3.09E+07**	**2.10**
Radiant Efficiency	**0.53**	**0.5413**	**2.13**
Radiant-Convection heater Cylindrical type			
Total heat duty (J/s)	**3.45E+07**	**3.45E+07**	**0.00E+00**
Radiant heat duty with assumed radiation % (J/s)	**2.346E+07**	**2.346E+07**	**0.00E+00**
Estimated radiation Heat duty (J/s)	**2.34E+07**	**2.34E+07**	**0.00E+00**
Convection heat duty based on assumed radiation %(J/s)	**1.09E+07**	**1.09E+07**	**0.00E+00**
Estimated convection zones heat flow QC (W)	**1.04E+07**	**1.07E+07**	**2.92E+00**
heater efficiency η %	**83.4**	**83.69**	**3.48E-01**

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