

THE APPLICATION OF SOFTWARE AUTOMATION STUDIO IN DESIGN AND WORK SIMULATION OF HYDRAULIC SYSTEMS

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ABSTRACT

Software solutions for the design of hydraulic systems are usually integrated into software tools that combine automation processes with different characteristics (hydraulic, pneumatic, electric). Apart from design, they offer an integrated approach to system designing, from conceptual design through simulation to complete project management and documentation.

Automation Studio is a software tool for design, animation and simulation of complex automation processes. Its main purpose is to meet the specific practical or engineering requirements, as well as the requirements of staff training and testing of the system.

In this paper we shall try to explain the functioning Automation Studio, i.e. the part relating to the design of hydraulic systems and simulation of hydraulic systems operation.

Key words: Automation Studio, design, hydraulic system, simulation

1. INTRODUCTION TO AUTOMATION STUDIO

The software Automation Studio fulfills a wide array of requirements that are placed in front of softwares for design of automated processes, as well as differences in their physical characteristics (electrical, hydraulic, pneumatic, etc.), by inserting different modules into the basic application, [1, 2]. This means that the Automation Studio consists of a series of modules, which are designed to meet specific customer requirements such as: creating graphs, whether it is a hydraulic, pneumatic, electric or other functional circuits; simulation of work; printing results in a suitable form; formation of different reports on the system as well as specification of the components used.

The core of the software Automation Studio consists of three parts: Diagram Editor, Project Explorer and Library Explorer, [2]. Diagram Editor is aimed to generate diagrams and to simulate the operation of the system represented by the diagram, as well as to create different reports, while Project Explorer performs management and classification of all documents associated with the simulation project. Library Explorer supports a library of symbols necessary to create diagrams that make up the project. Automation Studio is an application designed to run in the Windows environment, so that the logic of work with files (Open, Close, Save, Print, ...) and generally is the same as in other Windows applications, as well as operations on the objects within the project are very similar to the same in programs such as Microsoft Word, Excel, etc.

2. DESIGN OF FUNCTIONAL HYDRAULIC CIRCUIT USING THE SOFTWARE AUTOMATION STUDIO

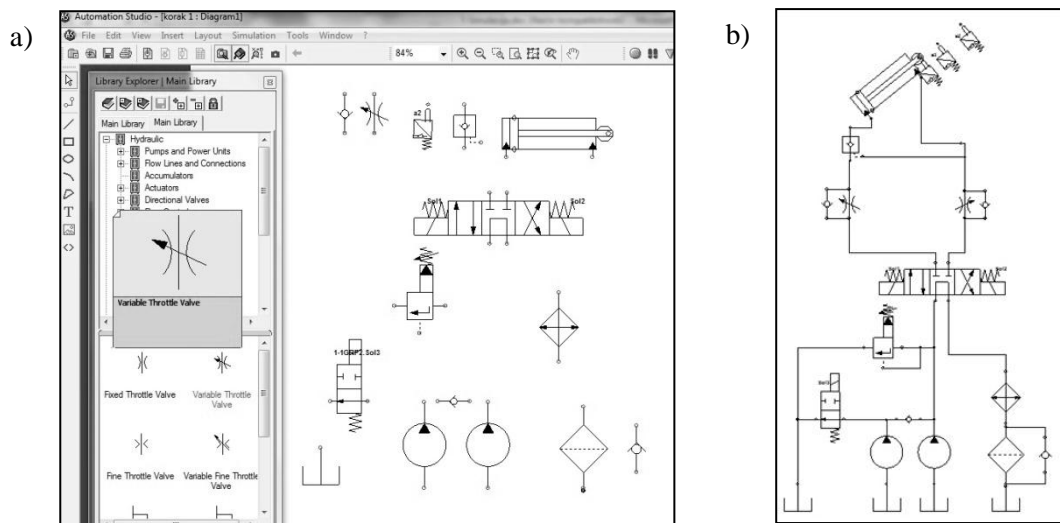
2.1. Creating diagrams

Using the feature - Library Explorer, which includes a library of hydraulic components symbols (DIN ISO 1219), the desired components (hydraulic pump, tank, valves, etc.) are put in the drawing area.

If the desired symbol can't be found in Library Explorer, like different types of valves with large number of different design schemes and regulation, it can be easily formed and added to the scheme.

The process of forming the symbol of a new component is based on the use of existing symbols and some amendments and adaptations using the Component Properties. These new symbols can be used for the formation of blocks of symbols that, once established, can be used in future projects.

The process of system components insertion in space for drawing diagrams and an example of the hydraulic system created in Automation Studio is shown in Figure 1.a.



Slika 1. a) System components insertion during creation of hydraulic system scheme; b) hydraulic system scheme created in Automation Studio

Depending on the need, component symbols can be displayed even after printing drawings or may be increased, decreased, arbitrarily rotated and translated.

After entering, it is necessary to connect the components with components of hydraulic pipelines and fittings.

2.2. The choice of component parameters

After the formation of hydraulic system scheme it is possible to simulate functionality of the system. However, this hydraulic system is unreal as each of internal components has been assigned predefined characteristics in the basic program setting. This phase can be used to simulate the flow of fluid in the hydraulic system, and verify the functionality and accuracy of the formed functional hydraulic circuit, but not to simulate realistic system under load.

To simulate the real hydraulic system it is necessary to assign the appropriate technical characteristics to the system components and to load the executive parts of the system in accordance with requirements of the construction.

It is important to note that the selection of components is based solely on calculation or designer's experience. The program does not offer a solution in this direction. The designer finds solutions based on real loads, the type of kinematic mechanism, manufacturer's recommendations and general guidelines for the design of hydraulic systems or analytical calculation. Of course, a detailed calculation is not necessary to perform because the parameters are easy to change, and the method of trial and test optimizes the system quickly and easily.

Finally, the selection of components and the speed to reach the optimal solution is a matter of the designer's experience.

The way of defining a hydraulic cylinder and all of its parameters such as stroke, piston and piston rod diameter, angle of inclination and mass load is shown in Figure 2.a.

The crucial moment for the simulation is defining the load in accordance with the required operating mode of the hydraulic system, i.e. the kinematic mechanism.

Formatting the graph of external loads acting on hydraulic cylinder is shown in Figure 2.b. In the simulation of complex systems, it is important to define when and at what stage of stroke external loads act upon hydraulic cylinder.

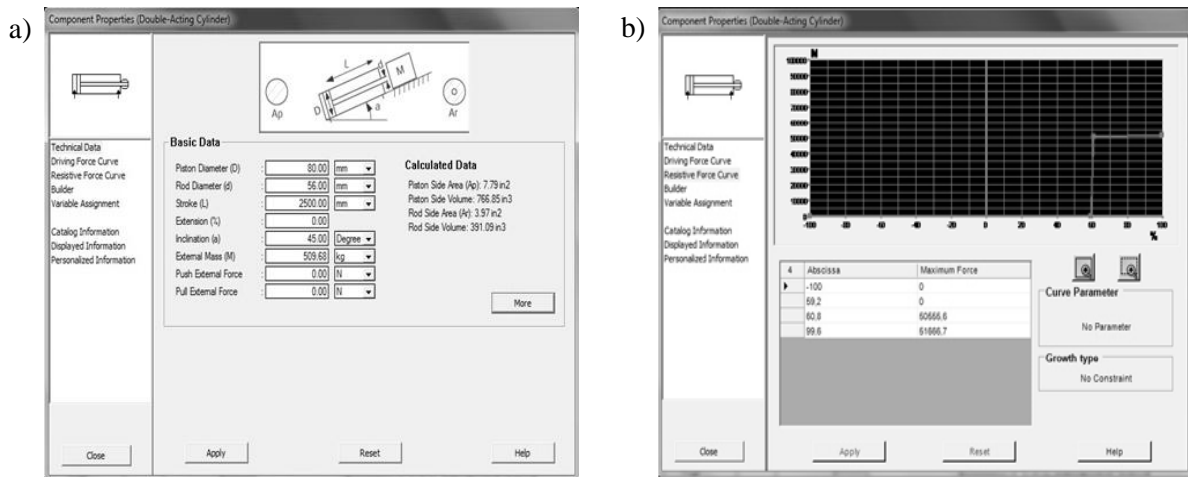


Figure 2.a) Definition of hydraulic cylinder parameters;
 b) Definition of hydraulic cylinder loads (load per cylinder stroke)

Automation Studio has the ability to integrate catalogues of various components of different manufacturers, which allows the user faster selection and specification, and even an accurate estimate of the projected cost of the system, [3].

3. SIMULATION OF WORK AND PARAMETERS OF HYDRAULIC SYSTEM USING SOFTWARE AUTOMATION STUDIO

After defining all the structural and operating parameters, components and loads and forming electrical scheme, the simulation of the system can be run. The result of simulation is the movement and operation of the hydraulic system in real time.

Another advantage of the Automation Studio is the possibility to integrate of different systems. The program allows easy creation of electrical scheme and control mechanism of the hydraulic system, which makes the simulation closer to real systems. The electric schemes with the possibility to turn on and off different components of the hydraulic system can simulate all phases of hydraulic system operation (start, stop, inactivity) in accordance with the requirements.

When the simulation runs it is not possible to add or subtract the components, change variables, or perform operations that change the design of the functional circuit. During simulation, it is possible to regulate the speed of the simulation in order to make display more effective as well as to change certain parameters (for instance, pressure for opening the dump valve, pump capacity, damping of the throttle valve and so on) in order to see what differences appear in the system operation.

Simulation shows the functioning of the system, so it is possible to estimate whether the system meets the requirements of the kinematic mechanism. In addition it is possible to perform the different measurements of output parameters such as pressure and pump flow, the speed and acceleration of the cylinder, the cylinder position, etc.

The simulation of hydraulic system in Automation Studio is presented in Figure 3.a. All of these parameters can be viewed simultaneously in real time using the feature Plotter, which is of particular importance. Using the Plotter different curves for the selected parameters can be shown. Plotter is triggered simply by entering the component in the plotter window and selecting the parameters to be monitored.

The main advantage of simulation is the possibility of quick and easy adjustment of parameters, as well as necessary components to optimize the system. For example, adjustment of executive organs speed can be performed using the plotter during simulation by changing the degree of opening of the throttle valve, Figure 3.b.

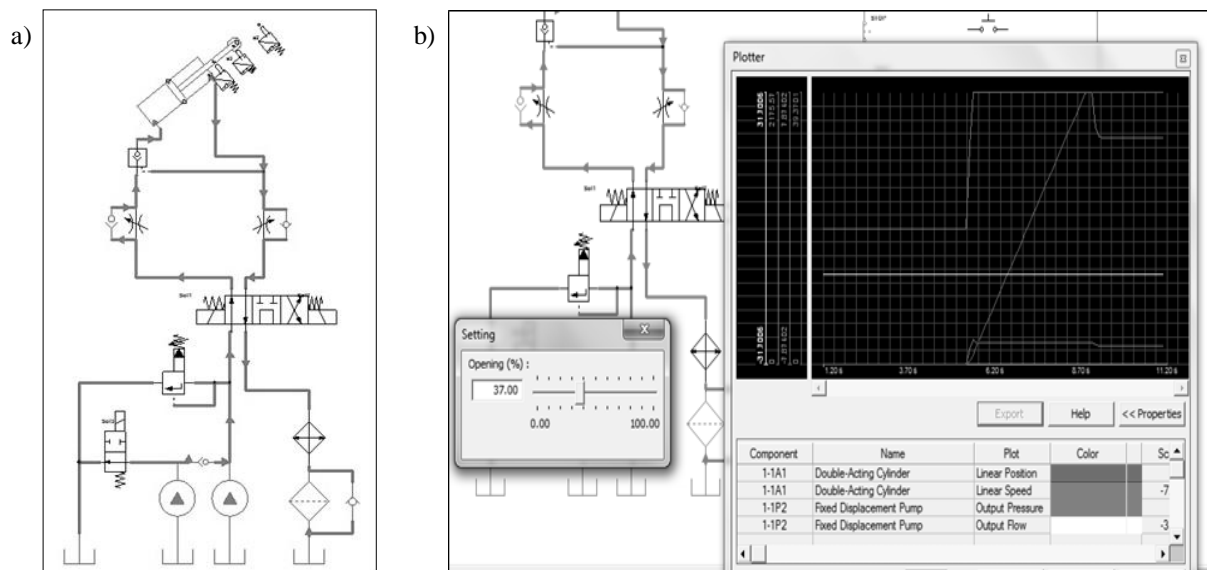


Figure 3. a) Simulation of hydraulic system operation;
b) Adjustment of the degree of opening of the throttle valve in real time

4. CONCLUSION

Automation Studio is a very powerful tool for designing automation processes and systems with hydraulic, pneumatic and electrical characteristics, [1]. The modular concept of the software allows the integration of different functions in the design of hydraulic systems, from design, component selection and integration of product catalogues to simulation of system operation in real time.

The possibility of system parameters simulation, user-friendly environment and attractive graphic design, make the software Automation Studio an attractive tool for use in the design of hydraulic systems. In addition it is especially important to emphasize its primary purpose, i.e. fulfillment of specific practical (engineering) requirements, as well as the requirements of staff training and testing of the system, [4].

5. REFERENCES

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