

Investigation of Authorware Application for Power Production Teaching

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Abstract—In order to solve the difficulty that beginner can not understand and grasp basic knowledge of thermal power plant in a short time, static demo, dynamic demo and test questions were done by using the construction design function of Authorware. The result shows that the frameworks design of Authorware have similarities to industrial process structure. After the software is run, equipments and its functions of thermal power plant can be displayed clearly from the static pictures and process of animation selective catalytic reduction denitrification can be exhibited vividly from dynamic scenes. Besides, test questions can help courseware learners to consolidate basic knowledge of thermal power plant. Moreover, selective catalytic reduction denitrification process of thermal power plant is regarded first as a sample to apply for teaching practice of power production.

Keywords: Authorware, power production teaching, selective catalytic reduction, denitrification

I. INTRODUCTION

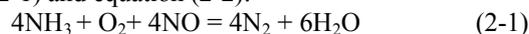
Nitrogen oxide is one of the main pollutants emitted by thermal power plant, which has a large proportion in the air pollutant. In order to solve the pollution problem of nitrogen oxide in power plant, a variety of control and emission reduction measures are applied [1-3]. At present, emission reduction methods commonly used are NOx control technology during combustion such as low nitrogen combustion technology, circulating fluidized bed combustion (CFBC) technology, integrated coal based combined cycle (IGCC), clean coal power generation technology and flue gas denitration technology based on selective catalytic reduction (SCR), selective non catalytic reduction (SNCR), SCR/SNCR joint technology [4-15]. All kinds of technology according to their characteristics have different applicable scope and development directions, but it needs to take a lot of energy and time for beginners to master relevant knowledge. In order to master the design content and process more easily for beginners, multimedia software, Authorware, is used to teaching, test or research [16-24]. However, it still is not used to electrical engineering teaching, especially for thermal power production. Thus, SCR system with a logistics process as an example for electrical production teaching by the form of illustration is used to teaching practice. It

facilitates understanding and grasping denitrification process of power system for some learners.

II. SYSTEM OF SELECTIVE CATALYTIC REDUCTION

A. Basic Principle of Process

SCR technology is a process that a reducing agent NH_3 or urea with NO and NO_2 in the role of the catalyst, reacts to generate N_2 and H_2O , but a reducing agent is not oxidized by O_2 . The main reactions are written from equation (2-1) and equation (2-2):



B. Technological Process

The SCR system generally includes a catalyst reaction chamber, ammonia storage and transportation system, ammonia and air mixture system, ammonia injection system, bypass system and the relevant test control system. The flue gas denitrification process flowchart is shown in Fig.1.

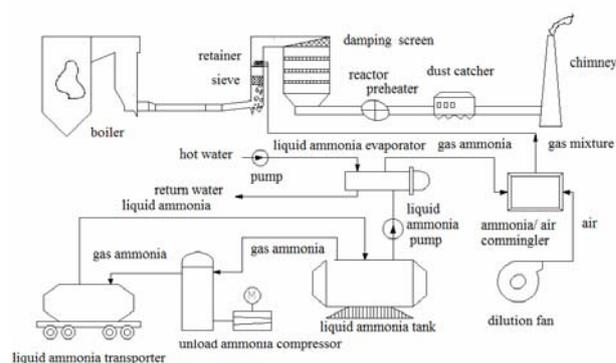


Figure 1. Schematic diagram of SCR denitrification system

The denitrification process is described as follows:

After liquid ammonia is transported to plant by tanker, it will be downloaded to the liquid ammonia storage tank by compressing pump. Then liquid ammonia in the liquid ammonia storage tank under their own steam balance pressure is sent to transport liquid ammonia gas evaporator, the generated ammonia in mixer forms a mixture with air

and ammonia concentration is dropped to less than 5%, the safety concentration. Ultimately, the ammonia is sprayed into the flue pipe by injection grid, flue gas with ammonia is fully mixed and enters the catalyst layer. Under the action of catalyst NO_x is removed.

Flue gas with high dust from the boiler economizer outlet across the large particles grey filter in the flue pipe and gradient rectifying grid and enter vertical SCR reactor with catalyst. After denitration reaction is completed the flue gas successively pass through the filter, integrated device into air preheater, electric dust collector, the blower and the desulfurization device, and finally discharges into the atmosphere from the chimney.

III. PRODUCTION OF DEMO SOFTWARE

In order to make beginners of the power engineering understand denitrification technology process of thermal power plant in a relatively short period and expand the computer software application in education and teaching, modular design function of Authorware will be used to demonstrate clearly thermal power plant of selective catalytic reduction technology process and to transfer basic knowledge under the static and dynamic form related to them. The design framework is shown in Fig. 2, which mainly consists of recognition system, the system operation and theory testing.

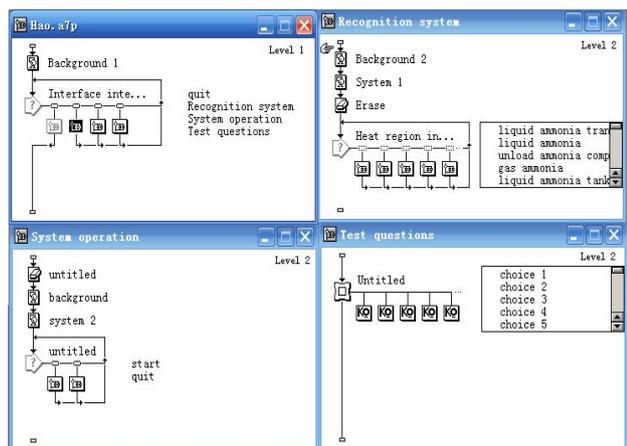


Figure 2. Software design framework

From Fig. 2 we know that basic icons of Authorware such as display icon, interactive icon, frame icon, knowledge object icon, group icon and the characteristics and integrated use of those icons can complete the framework design of the system.

A. Static Demo

First of all, drag a display icon to design interface and adjust the attributes and specific functions, create and display an interface as shown in Fig. 3. Then, using inserting object function of displaying icon of Authorware, the system diagram drawn by Autocad software is imported into the design software, as shown in Fig. 4. Then, make static cognition system. Analyze coal-fired power plant combustion system, selective catalytic reduction system, equipment, process in this part and know the entire equipment name and their respective roles, and then make "static cognition system".

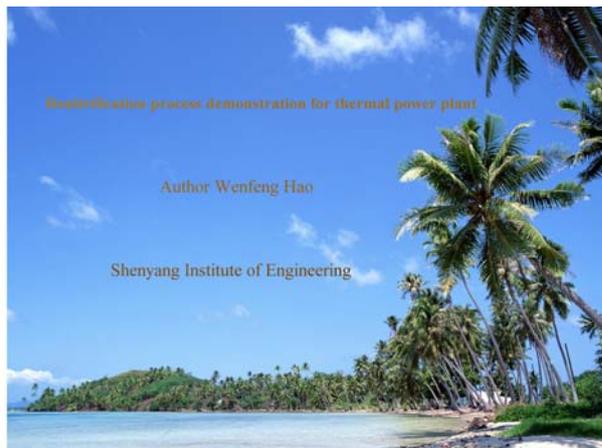


Figure 3. Initial interface design software

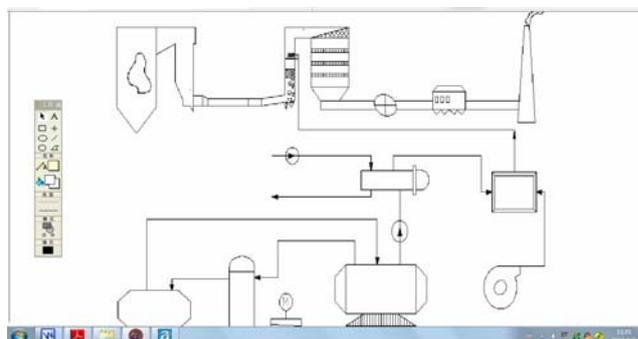


Figure 4. Import of system diagram

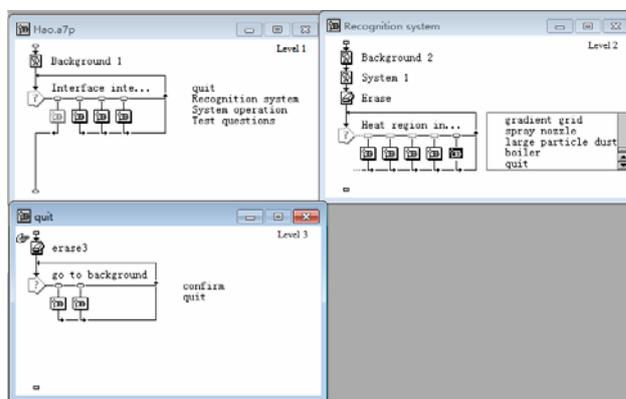


Figure 5-a. "Cognition system" structure diagram

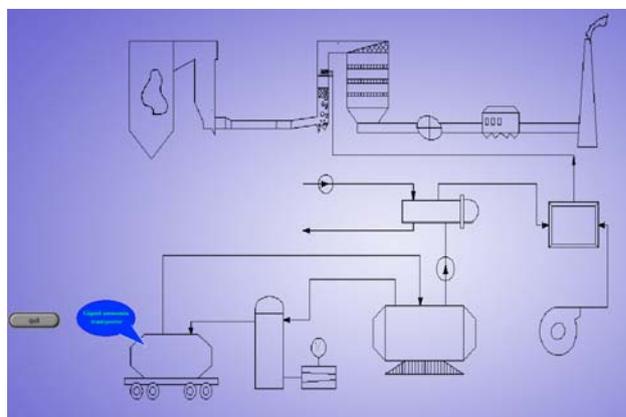


Figure 5-b. Static flow diagram for the equipment and process

This part mainly uses thermal interaction icon. Drag a group icon and display icon into flow line, then describe the name, equipment structure and function, and set a hot region. Regional scope is fixed on the device, set a click. When click is done introduction of the equipment including structure and function will be shown. The software users can understand and study the system by the static demonstration of this process. The design levels of the Authorware and display results of equipment and system are shown in Fig. 5-a and Fig. 5-b, respectively.

Besides, button operation is applied into the design and operation of the system. Use a button to control the flow of the material in different parts to facilitate the users of the software of the courseware of understanding, operation and intuitive understanding of the process. If you press the operation, the flow of material such as flue gas, mixed ammonia can be clearly displayed according to the direction of flow, specific practices are indicated in dynamic demo section.

B. Dynamic Demo

Prior to schematic diagram generation for the selective catalytic reduction of dynamic denitrification, the main systems of thermal power plants including combustion system, steam and water system and electrical system should be fully understood and master system in material, energy conversion and transfer process.

SCR denitrification dynamic system includes mainly flue gas system, discharge system of ammonia, liquid ammonia evaporation supply and reaction system, the demonstration interface is shown in Fig. 6.

For the production of dynamic demonstration of the operating system, smoke movement demonstration as a sample is used to illustrate all kind of processes in this paper. Coating as shown in Fig.7 indicates that flow direction of the flue gas, whose run process can show process control of flue gas in the system. The process using Authorware production can be described as follows:

Using button function of interactive icon "start-up" and "quit" are set up. Under the condition of the start-up button, through different levels of "group" icons the equipment and parts of different substances flow according to the order will be arranged in the upper and lower levels of the "group" icons, also special effects of the coating for each diagram are set.

After the program is run different substances will come out in an order with different special effects, and ultimately you will feels that the substance is flowing, the schematic diagram of the production process is shown in Fig. 8.

In order to increase understand and grasp the basic knowledge of selective catalytic reduction technology in thermal power plant, functions of navigation and knowledge object are applied to make test questions. Production procedures of test questions are described in following section.

C. Production of Test Questions

During the production of the test questions, a background icon, navigation icon and some knowledge object icons are firstly dragged into a group icon of test questions framework icon.

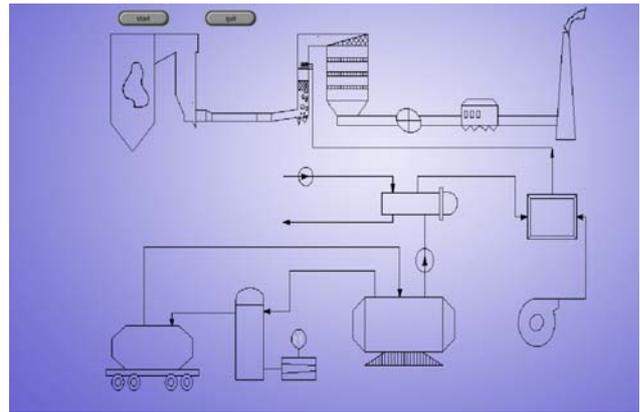


Figure 6. SCR denitrification operation interface

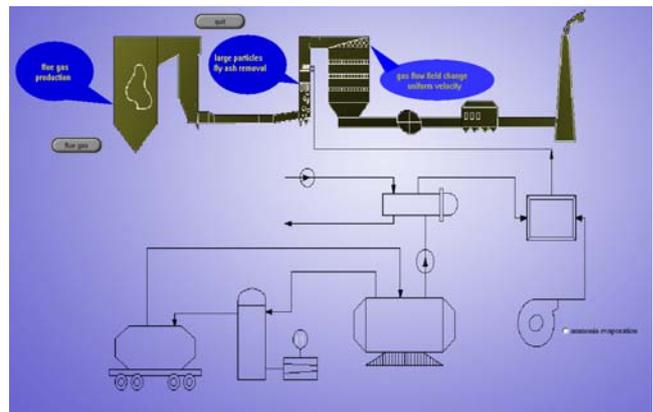


Figure 7. Flue gas flow chart

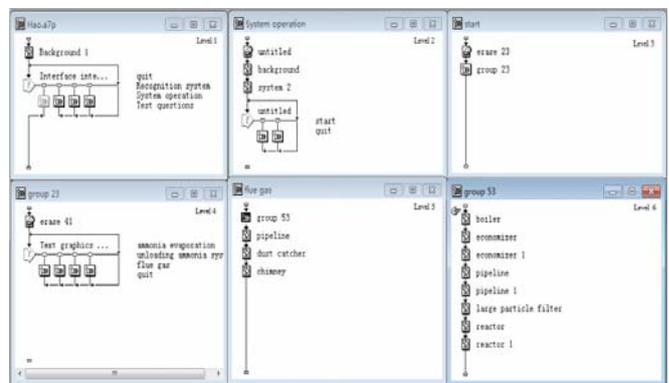


Figure 8. Production chart of flue gas flow

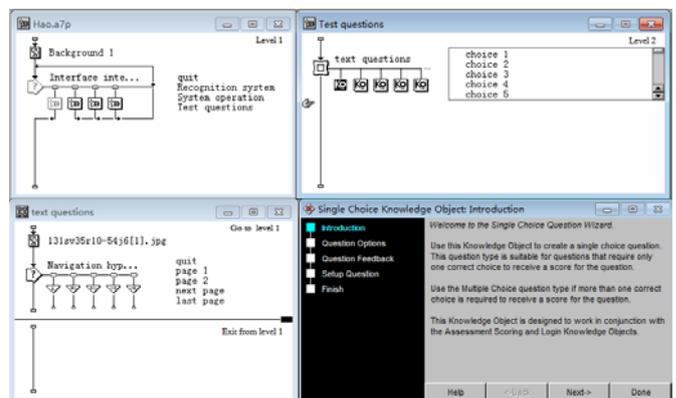


Figure 9-a. Production process of "test questions"

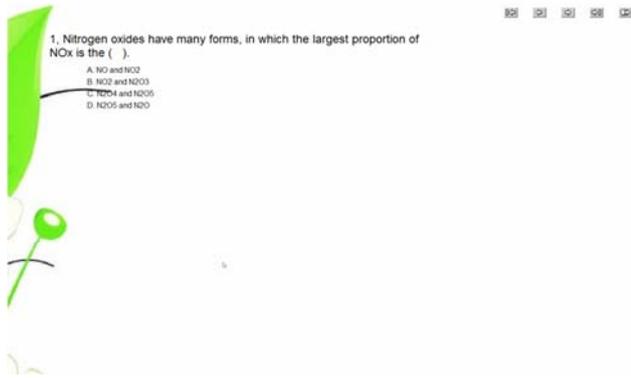


Figure 9-b. Run schematic diagram of test questions

Then selection responses including page size, background, types and number are done according to page hint.

Twenty single-choices, production procedures and effects example are shown in Fig. 9-a and Fig. 9-b, respectively. Through the study of the production process and the selective catalytic reduction of knowledge, the software users will have a deep understanding of the software itself and the basic knowledge of the environmental protection for thermal power plant.

IV. CONCLUSIONS

Following conclusions can be drawn by using production and discussion related to process demo of selective catalytic reduction denitration:

1. Process flowchart and basic knowledge of selective catalytic reduction of thermal power plant can be demonstrated clearly under the static state and dynamic state by the modular design function of Authorware.

2. Test question section can help learner understand and grasp basic knowledge of environmental protection for thermal power plant.

3. Software users can not only have a more profound understanding of the material, energy conversion and transfer process of thermal power plant, but also can master the method of process modular design, especially for Authorware.

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