Design and Implementation of Welding Procedure Qualification Expert System

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Abstract. Welding process evaluation is an important link to ensure the quality of welding engineering and determine the welding process specification. It is also the main procedure to evaluate the welder's examination results. In the traditional way of processing WPS documents, the test results are usually judged manually by experts based on experience. However, the evaluation of welding process is often very complex, involving the base material, sample type, process parameters and a large number of international standards. Therefore, how to utilize the software engineering method and experience, make the welding process evaluation program accurate and efficient information, make the welding process evaluation program easier and more efficient, is very important to the whole field of welding.

1. Introduction
Process design runs through the whole production process. Process design not only involves the production type, product structure, process equipment and production technology level of the enterprise, but also is restricted by the practical experience of the process designer and the production management system. Any change of any factor may lead to the change of process design scheme. Because of this, process design is the most active factor in the production activities of enterprises, and the dependence of engineering design on its use environment inevitably leads to the dynamic and empirical nature of process design. Traditional process design is manually developed, which inevitably has some disadvantages [1]: high requirements for process designers; Heavy workload and low efficiency; Unable to use CAD graphics and data; It is difficult to ensure the accuracy of data; Information cannot be shared, etc.

Welding procedure qualification is a necessary process to determine welding procedure specification and welding material, and it is also a process of time consuming [2], laborious and increasing labor cost. Due to the complexity of the evaluation process and the diversity of welding parameters, a large number of process evaluation and welding procedures have been accumulated and repeated in enterprises, which cost a lot of manpower and material resources. Therefore, in order to improve the efficiency and avoid repetition, it is urgent to use computer to manage the welding procedure [3].

2. Design of Welding Process Formulation and Evaluation System
The system prepares a database of computer data for welding processes according to ISO 15614-1 and ISO 14732. Users can input, store, modify and query all kinds of databases such as base material, welding material, groove chart, etc., or print all kinds of reports according to their needs. The system includes welding process design module and welding process evaluation module. The module adopts...
the retrieval method with welding method and metal thickness as the key to infer groove form, groove parameters, welding process parameters and welding materials; The choice of joint groove is based on plate thickness; Welding parameters are determined by metal type and welding method. And different welding methods, the same metal type, there will be different welding materials, according to the metal type and welding method to determine the choice of welding materials [4].

Figure 1. Module flow of welding procedure design

Figure 2. Module flow of welding procedure qualification
The welding process design module and welding process evaluation module contained in the system can be used separately or in combination. The main features of the system are as follows: (1) it can query the welding process specification and welding process evaluation report according to the initial conditions such as the base material; (2) for the database no record of welding process, welding process design module can according to the parent metal, such as initial conditions for welding process design, and then into the module, welding procedure qualification for system for the corresponding welding procedure qualification report directly to give results for unrecorded, welding procedure qualification module is recommended process parameters is given information and related information (industrial evaluation test) performance experiment, and qualified welding process is obtained. This system not only has the function of welding process data management but also has the function of intelligence.

3. Software Design

3.1. Establishment of Database
The data information included in the design and evaluation of welding process includes: metal type, groove form, welding process parameters, welding materials, etc. For a variety of different welding methods, characteristics and so on many factors, so all kinds of welding method has the different welding design, it will be classified according to the different characteristics of welding methods respectively, with different welding methods using different design methods and calculation steps, in order to obtain the reasonable welding data, is used for welding process design process. The database includes the following types:
- base material database
- groove pattern gallery
- welding process parameters database
- welding material database
- welding procedure qualification report database
- auxiliary database

![Figure 3. Structure of database](image)

3.2. Software Function

3.2.1. Parameter input interface
Firstly, input the base material, joint form and welding method in the software interface. The input of the base metal is the steel number of the input base metal; The joint forms include common joint forms, which are mainly determined according to the form of welded components, stress status, service conditions and construction conditions; The selection of welding methods includes common welding
methods. Different welding methods correspond to different welding parameters. Groove design takes into account joint load condition and plate thickness (penetration requirements).

3.2.2. Function introduction
When enters the welding process formulation and evaluation system, there are five forms of main menu, such as inquiry, maintenance, printing, help and exit, and specific inquiry is entered according to needs. At the beginning of the query, the first initialization, basic data input by the user, such as the parent material of; the thickness of the parent metal, welding method and so on, and then the computer, according to a database to determine internal support is welded on to the base of welding process parameters, welding material and a series of process conditions, finally get the welding procedure specification required. The specific functions of each module are as follows:
- various database management modules. This module establish a variety of standard databases, and by adding and updating records in the database to adapt to user management and query.
- groove pattern gallery
- welding process design module. According to the requirements of production and initial conditions, the welding procedure can be designed automatically and the existing procedure can be edited, modified, inquired and deleted.
- Welding procedure qualification module. The database of welding procedure evaluation report is established on the computer, and the existing procedure evaluation report is dynamically managed, inquired and edited, and the welding procedure specification supported by the procedure evaluation report is generated, and the function of necessity judgment of evaluation experiment is also supported.

This system is basically an automatic intelligent system, which avoids repeated welding process evaluation, facilitates the design, management and query of welding process regulations, and solves the corresponding problems existing in current enterprise welding management. Therefore, this system can save a lot of capital and labor cost for manufacturers, and provide a shortcut for enterprises to improve labor productivity.

4. Conclusion
Development of welding process and the software, can the welding production and welding process of enterprises to develop and assess effective management and query [5], using database automatically generate welding process and process instructions, and provides a convenient method of the database to add, enterprise can according to need to add and update the database of welding. The development of this system will improve the quality of process design, provide scientific basis for enterprises to improve management, and realize the standardization and standardization of process [6].

5. References
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