

DESCRIPTION

TITLE OF INVENTION:

SEAL HANDLING, SEAL HANDLING MANAGEMENT AND SEAL HANDLING
TRAINING SYSTEM, PROGRAM AND METHOD

5

TECHNICAL FIELD

[0001]

The present invention relates to a seal handling system used
for piping coupling etc., and seal handling management/seal
handling training system, program, and method.

10

BACKGROUND ART

[0002]

When a seal handling is performed for coupling pipes or
connecting equipment such as a pump to a pipe, a sealing material
such as a gasket is sandwiched between parts of a flange joint,
and the gasket is tightened with bolts arranged at multiple
positions of the flange joint.

15

[0003]

Regarding this seal handling, it is known that a tightening
force of a bolt tightened by a tightening tool such as a torque
wrench is detected by a load cell in training equipment and displayed
on a display to allow a worker to confirm a surface pressure of
a flange (e.g., Patent Literature 1).

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25

CITATION LIST

PATENT LITERATURE

[0004]

Patent Literature 1: Japanese Laid-Open Patent Publication
No. 2009-191932

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SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005]

Such seal handling comprises multiple elements including a plant, a client such as an owner thereof, a seal handling object such as a device requiring seal handling, a contractor and workers in charge of seal handling, a sealing material suitable for the seal handling object, a seal handling tool used for seal handling, and training of workers. In particular, selection and purchase of a sealing material and training of workers are extremely important factors for improving the accuracy and reliability of the seal handling.

10 [0006]

It is not easy to select a suitable sealing material from various sealing materials, and even skilled workers cause problems in accuracy and reliability if the seal handlings are dependent on intuition and experience. Even though seal handling training is performed, expected accuracy and reliability cannot be obtained if a contractor makes a mistake in selection of the sealing material.

15 [0007]

Even when a high-precision high-quality sealing material is provided, high-quality seal handling cannot be expected if the selection is mistakenly made. IF the training for the seal handling, the selection of sealing material, and the purchase thereof are freely separately managed, it is difficult to enhance the quality of the seal handling, resulting in deterioration in quality of the seal handling.

20 [0008]

25 [0008]

In view of the problem, an object of the present invention is to implement unified management of seal handling training, sealing material selection, and seal handling and to enhance the accuracy and reliability of the seal handling.

30 [0009]

Another object of the present invention is to unify sealing material selection with sealing material purchase to enhance the quality and reliability of sealing material in the seal handling.

SOLUTION TO PROBLEM

[0010]

To achieve the objects, an aspect of a seal handling system of the present disclosure provides a seal handling system linking a client to order a seal handling, a contractor to receive a contract for the seal handling, and a support center to support the seal handling. An instruction for receiving a seal handling training at the support center is issued from the client to the contractor. The seal handling by the contractor is permitted on condition that the seal handling training for the contractor is received at the support center in response to the instruction for receiving the training.

In the seal handling system, additionally, in response to the instruction for receiving the training from the client, a sealing material necessary for the seal handling may be selected or information of the sealing material may be provided, and a procurement instruction for the sealing material may be issued from the client to the contractor.

To achieve the objects, an aspect of a seal handling system of the present disclosure provides a seal handling system linking a client to order a seal handling, a contractor to receive a contract for the seal handling, and a support center to support the seal handling. An instruction for receiving a seal handling training at the support center is issued from the client to the contractor. In response to the instruction for receiving the training from the client, the seal handling training is performed for the contractor at the support center, and a sealing material necessary for the seal handling is selected or information of the sealing material is provided. A procurement instruction for the sealing material is issued from the client to the contractor, and the seal handling is permitted on condition that the seal handling training is received.

[0011]

To achieve the objects, an aspect of a seal handling management

method of the present disclosure provides a seal handling management method performed by linking a client computer, a contractor computer, and a support center computer. The method includes a step of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center and a procurement instruction for both a sealing material and a seal handling tool or at least the sealing material; and a step of, by the support center computer, managing the seal handling training and receiving an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material.

To achieve the objects, an aspect of a seal handling management method of the present disclosure provides a seal handling management method performed by linking a client computer, a contractor computer, and a support center computer. The method includes a step of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing material and a seal handling tool or for at least the sealing material; a step of, by the support center computer, managing the seal handling training and receiving an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material; a step of, by the contractor computer, notifying at least the client computer of an attendance report of the seal handling training; and a step of, by the client computer, receiving the attendance report of the seal handling training from at least the contractor computer to issue permission for a seal handling using the sealing material to the contractor computer.

[0012]

The seal handling management method may further include a step of, by the support center computer, managing at least one of the seal handling, the seal handling training, and purchase of the sealing material, the at least one being related to at least the

client computer or the contractor computer.

[0013]

The seal handling management method may further include a step of, by the support center computer, issuing a seal handling promotion to the client computer before an instruction for a seal handling from the client computer to the contractor computer.

[0014]

The seal handling management method may further include a step of, by the support center computer, acquiring a record of the seal handling and presenting seal handling information to at least the client computer or the contractor computer.

[0015]

In the seal handling management method, the seal handling tool may include a flange peripheral member, a tightening tool, and an information terminal storing flange tightening information.

[0016]

To achieve the objects, an aspect of a seal handling management system of the present disclosure provides a seal handling management system including a client computer, a contractor computer, and a support center computer in a linked manner. An instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing material and a seal handling tool or for at least the sealing material are issued from the client computer to the contractor computer. The support center computer manages the seal handling training and receives an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material.

To achieve the objects, an aspect of a seal handling management system of the present disclosure provides a seal handling management system including a client computer a contractor computer and a support center computer in a linked manner. An instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing material and a seal

handling tool or for at least the sealing material are issued from the client computer to the contractor computer. The support center computer manages the seal handling training and receives an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material. The contractor computer notifies at least the client computer of an attendance report of the seal handling training. The client computer receives the attendance report of the seal handling training from at least the contractor computer to issue permission for a seal handling using the sealing material to the contractor computer.

[0017]

To achieve the objects, an aspect of a seal handling management program of the present disclosure provides a seal handling management program for causing a client computer, a contractor computer, and a support center computer to implement a function of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing material and a seal handling tool or for at least the sealing material; and a function of, by the support center computer, managing the seal handling training and receiving an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material.

To achieve the objects, an aspect of a seal handling management program of the present disclosure provides a seal handling management program for causing a client computer, a contractor computer, and a support center computer to implement a function of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing material and a seal handling tool or for at least the sealing material; a function of, by the support center computer, managing the seal handling training and receiving an instruction from the client

computer to select a sealing material necessary for a seal handling or acquire information of the sealing material, and, by the contractor computer, notifying at least the client computer of an attendance report of the seal handling training; and a function of, by the client computer, receiving the attendance report of the seal handling training from at least the contractor computer to issue permission for a seal handling using the sealing material to the contractor computer.

[0018]

To achieve the objects, an aspect of a seal handling training method of the present disclosure provides a seal handling training method including the steps of selecting a device required for a training from seal handling devices disposed in one or more training rooms, the seal handling devices including a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger ; and acquiring training information from a sensor output of a sensor included in each of the seal handling devices or from an input means.

To achieve the objects, an aspect of a seal handling training method of the present disclosure provides a seal handling training method including the steps of selecting a device required for a training from seal handling devices disposed in one or more training rooms, the seal handling devices including a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger; acquiring training information from a sensor output of a sensor included in each of the seal handling devices or from an input means; receiving the sensor output or the training information to generate simulation information related to a device included in the seal handling devices; and presenting the simulation information as

either or both of character information and graphic information.
[0019]

To achieve the objects, an aspect of a seal handling training system of the present disclosure provides a seal handling training system including one or more training rooms; a seal handling means disposed in the one or more training rooms, the seal handling means including at least one device of a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger; an acquiring means that acquires a sensor output of a sensor included in each device of the seal handling means or training information related to the device; a processing means that receives the sensor output or the training information to generate simulation information related to a device included in the seal handling means; and an information presenting means wired or wirelessly connected to the processing means, the information presenting means presenting a process output from the processing means as either or both of character information and graphic information.
[0020]

To achieve the objects, an aspect of a seal handling training program of the present disclosure provides a seal handling training program for causing a computer to implement the functions of selecting a device used for a training from a seal handling means including at least one device of a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger; acquiring a sensor output of a sensor included in each device of the seal handling means or training information related to the device; receiving the sensor output or the training information to generate simulation information related to a device included

in the seal handling means; and presenting the simulation information as either or both of character information and graphic information.

5 ADVANTAGEOUS EFFECTS OF INVENTION

[0021]

According to the seal handling system of the present invention, any of the following effects is obtained.

[0022]

10 (1) In response to the arrival of time for seal handling, the promotion of the support center, etc., consistent involvement can be achieved in terms of the selection of sealing material, the training of the seal handling, the procurement of sealing material, and the seal handling so as to achieve the safe and secure seal
15 handling.

[0023]

(2) The sealing material necessary for the site can be selected or the information thereof is provided, and the seal handling training can be performed with the sealing material based on the
20 selection or the provided information, so that the training can be conducted in accordance with the seal handling site.

[0024]

(3) The worker having received the seal handling training performs the seal handling at the site with the selected sealing
25 material, so that the high-precision and reliable seal handling can be performed.

[0025]

According to the seal handling management system, program, or method of the present invention, any of the following effects
30 is obtained.

[0026]

(1) The client computer, the contractor computer, and the support center computer can be linked to each other to implement unified management of the seal handling training for the contractor,

and the selection and purchase of the sealing material, so as to increase the accuracy of the seal handling and improve the reliability.

[0027]

5 (2) Duties of the client, the contractor, and the support center in the seal handling are clearly segregated through the client computer, the contractor computer, and the support center computer, so that the seal handling training, and the selection and procurement of sealing material can be automated.

10 [0028]

 (3) The support center can collectively manage the seal handling instruction from the client, the seal handling by the contractor, and the selection, procurement instruction and sale of the sealing material, so that the support center can comprehend
15 the contents of the seal handling and provide the record contents thereto to the client and the contractor.

[0029]

 (4) The histories of the seal handling training, the selection and procurement of the sealing material, and the seal handling can
20 be recorded, and the recorded information can be presented to enable confirmation of the contents thereof.

[0030]

 According to the seal handling training system, program, or method of the present invention, any of the following effects is
25 obtained.

[0031]

 (1) The client computer, the contractor computer, and the support center computer can be linked to each other to select an object device of the client's seal handling to perform the seal
30 handling training with the device and acquire simulation information or training information of the object device of the client's seal handling, which can contribute to an improvement in the accuracy and reliability of the seal handling.

[0032]

(2) Through the client computer, the contractor computer, and the support center computer, the seal handling training, and the selection and procurement of sealing material can be automated.
[0033]

5 (3) The sealing material necessary for the contractor performing the seal handling for the client can be selected, and the seal handling training using the sealing material and the training with the device related to seal handling can be performed, while the management thereof can be performed at the support center,
10 so that the seal handling training integrated with the seal handling can be implemented.
[0034]

(4) The result of the seal handling training can be utilized for the selection and procurement of sealing material, and the seal
15 handling. The training history can be recorded, and the record information thereof can be presented to facilitate confirmation of the contents.

BRIEF DESCRIPTION OF DRAWINGS

20 [0035]

Fig. 1 is a diagram of a seal handling system according to a first embodiment.

Fig. 2 is a diagram of a process sequence of the seal handling system.

25 Fig. 3 is a diagram of a seal handling management system according to a second embodiment.

Fig. 4 is a diagram of a process sequence of seal handling management.

30 Fig. 5 is a diagram of a process sequence of seal handling management.

Fig. 6 is a diagram of a sealing material data table of a sealing material selection system.

A of Fig. 7 is a diagram of an input screen used for sealing material selection and B of Fig. 7 is a diagram of an output screen

showing a result of sealing material selection.

Fig. 8 is a flowchart of a process procedure of sealing material selection.

Fig. 9 is a diagram of a lecture system of a seal handling
5 training system.

Fig. 10 is a diagram of a practical training system of the seal handling training system.

A of Fig. 11 is a diagram of hardware of a PC and B of Fig. 11 is a diagram of hardware of a training server.

10 Fig. 12 is a diagram of a seal handling training information table.

A of Fig. 13 is a diagram of a personnel information table and B of Fig. 13 is a diagram of a sealing material information/seal handling information table.

15 A of Fig. 14 is a diagram of a training information table and B of Fig. 14 is a diagram of a related information table.

Fig. 15 is a diagram of a course curriculum table.

A of Fig. 16 is a diagram of a gasket's lecture contents table and B of Fig. 16 is a diagram of a gasket's practical training
20 contents table.

A of Fig. 17 is a diagram of a gland packing's lecture contents table and B of Fig. 17 is a diagram of a gland packing's practical training contents table.

Fig. 18 is a diagram of a lecture contents table.

25 Fig. 19 is a diagram of a practical training contents table.

A of Fig. 20 is a diagram of an example of an input screen for seal handling and B of Fig. 20 is a diagram of an example of an output screen showing completion of seal handling training.

30 Fig. 21 is a flowchart of a process procedure of a seal handling training program.

Fig. 22 is a flowchart of a process procedure of skill determination.

Fig. 23 is a flowchart of a process procedure of a course selection.

Fig. 24 is a flowchart of an example of a seal handling training method.

A of Fig. 25 is a view of a flange tightening practical training equipment according to Example 1 and B of Fig. 25 is a view of a
5 bolt including a strain sensor and a nut.

A of Fig. 26 is a view of a creep relaxation practical training equipment according to Example 2 and B of Fig. 26 is a view of a bolt including a strain sensor and a nut.

Fig. 27 is a view of a sealability practical training equipment
10 according to Example 3.

Fig. 28 is a view of a site simulation tightening practical training equipment according to Example 4.

Fig. 29 is a view of a piping alignment practical training equipment according to Example 5.

Fig. 30 is a diagram of a training table according to another
15 embodiment.

Fig. 31 is a diagram of a process sequence of a seal handling system according to another embodiment.

Fig. 32 is a diagram of a process sequence of seal handling
20 management according to another embodiment.

Fig. 33 is a flowchart of a process procedure of a seal handling training program according to another embodiment.

Fig. 34 is a diagram of an input screen for seal handling
according to another embodiment.

25

DESCRIPTION OF EMBODIMENTS

[0036]

[First Embodiment]

[0037]

30 <Seal Handling System>

[0038]

Fig. 1 shows a seal handling system according to a first embodiment. This seal handling system 2 includes a client 4, a contractor 6, and a support center 8, and is a seal handling system

linking these elements.

[0039]

The client 4 may be, for example, any of various plants such as oil refinery plants and chemical plants, electric power companies, manufacturing companies manufacturing ships or semiconductors, and owners thereof ordering a seal handling.

[0040]

The contractor 6 is a contractor receiving a contract for seal handling from the client 4.

10 [0041]

The support center 8 provides support for the seal handling to the client 4 and the contractor 6. This support includes training related to the seal handling, provision of sealing techniques, seal handling management, and sale of related members such as sealing materials and seal handling tools.

[0042]

Fig. 2 shows a process sequence of the seal handling system 2.

[0043]

20 According to this process sequence, the support center 8 performs promotion related to the seal handling to the client 4 (S101). In response to this promotion or the arrival of time for the seal handling, the client 4 issues an instruction for seal handling and an instruction for receiving a seal handling training at the support center 8 to the contractor 6 (S102). The support center 8 is also notified of this instruction.

[0044]

30 The contractor 6 issues an acceptance notification of the seal handling and the seal handling training to the client 4 and the support center 8 (S103).

[0045]

In response to the notification from the contractor 6, the client 4 issues an instruction for selection of sealing material to the support center 8 (S104).

[0046]

The support center 8 selects a sealing material in response to the notification of the seal handling and the seal handling training from the client 4 and the contractor 6 and the issuance of the instruction for selection of sealing material from the client 4 (S105). The support center 8 issues a notification of a sealing material selection result to the client 4 and the contractor 6 (S106).

[0047]

The client 4 issues an instruction for procurement of the sealing material to the contractor 6 (S107) and simultaneously makes a report thereof to the support center 8. On this occasion, the contractor 6 may purchase the sealing material and a recommended seal handling tool from the support center 8.

[0048]

The support center 8 performs a seal handling training using the selected sealing material for the contractor 6 (S108) and notifies the client 4 and the contractor 6 of the training result (S109).

[0049]

In response to the procurement of the sealing material and the result of the seal handling training, the client 4 issues a permission for seal handling to the contractor 6 (S110).

[0050]

Upon receiving this permission, the contractor 6 performs the seal handling specified by the client 4 (S111).

[0051]

<Effects of the First Embodiment>

[0052]

(1) The arrival of time for seal handling can be known from the promotion of the support center 8 etc.

[0053]

(2) In response to the arrival of time for seal handling, the promotion of the support center 8, etc., consistent involvement

can be achieved in terms of the selection of sealing material, the training of the seal handling, the procurement of sealing material, and the seal handling so as to achieve the safe and secure seal handling.

5 [0054]

(3) The sealing material necessary for the site can be selected before the seal handling, and the seal handling training can be performed with the sealing material, so that the training can be conducted in accordance with the seal handling site to enhance the accuracy of the seal handling.

10 [0055]

(4) The contractor 6 performs the seal handling with the selected sealing material at least on condition that the contractor has received the seal handling training, so that the high-precision and reliable seal handling can be performed.

15 [0056]

(5) According to the seal handling system 2, the support center 8 selects the sealing material, conducts the training of seal handling, and sells the sealing material, so that the procurement of the sealing material related to the seal handling can be unified.

20 [0057]

(6) According to the seal handling system 2, since the support center 8 is consistently involved in the selection of the sealing material and the training of the seal handling, the seal handling can be made highly precise while maintaining high reliability, and the seal handling can be made more efficient.

25 [0058]

[Second Embodiment]

[0059]

30 Fig. 3 shows a seal handling management system according to a second embodiment. In Fig. 3, the same portions as those of Fig. 1 are denoted by the same reference signs. The configuration shown in Fig. 3 is an example, and the present invention is not limited to this configuration.

[0060]

A seal handling management system 20 is a computer system that performs support processes of personnel information, sealing information, seal handling information, training information, related information, etc. in the seal handling system 2 described above by using a computer. The seal handling management system 20 includes a sealing material selection system for selecting a sealing material and a seal handling training system 34 (Fig. 9) for conducting a training described later for the contractor 6 performing the seal handling etc.

[0061]

This seal handling management system 20 includes, for example, a personal computer (hereinafter simply referred to as "PC") 24 as a client computer for the client 4, a PC 26 as a contractor computer for the contractor 6, a PC 28 as a support center computer and a training server computer (hereinafter simply referred to as "training server 30" for the support center 8. The seal handling training system 34 acquires sensor output of a sensor included in each device of a seal handling means or training information related to the device, generates simulation information related to the devices included in the seal handling means in response to the sensor output or the training information, and presents information for presenting a process output that is output from a processing means as either or both of character information and graphic information.

[0062]

For example, the PCs 24, 26, and 28 are linked through Internet 32. The training server 30 is wired or wirelessly connected to the PC 28.

[0063]

The processing of the PC 24 includes an instruction for seal handling, an instruction for training, an instruction for selection of sealing material, an instruction for procurement, and issuance of seal handling permission.

[0064]

The processing of the PC 26 includes a seal handling acceptance notification, a training acceptance notification, report of training attendance, report of sealing material procurement, seal handling start notification, issuance of seal handling completion notification, monitoring of seal handling, etc.

[0065]

The processing of the PC 28 includes promotion, confirmation of receipt of instruction and report, management of selection of seal materials, monitoring of training programs, determination of continuation of support, etc.

[0066]

The processing of the training server 30 includes execution of a seal handling training program, a sealing material selection program, etc.

[0067]

<Process Sequence of Seal Handling Management>

[0068]

Figs. 4 and 5 show a process sequence of seal handling management.

[0069]

The promotion related to seal handling is performed from the PC 28 to the PC 24 (S201). By coordinating the promotion with the arrival of time for seal handling, arrival of maintenance time can be announced in synchronization with the promotion.

[0070]

An instruction for seal handling is issued from the PC 24 to the PC 26, and the PC 28 is notified of the instruction (S202). This instruction is not a start of seal handling or a permission of seal handling and is merely a seal handling instruction conditional on a seal handling training described later etc.

[0071]

The PC 26 receiving this notification issues a seal handling acceptance notification to the PC 24, and notifies the PC 28 of the seal handling acceptance notification (S203). The PC 24

receiving this acceptance notification issues to the PC 26 an instruction for seal handling training at the support center 8, and notifies the PC 28 of the instruction for seal handling training (S204).

5 [0072]

The PC 26 issues the seal handling training acceptance notification, and notifies the PC 28 of the seal handling training acceptance notification (S205). This causes the PC 24 to issue an instruction for selection of sealing material to the PC 28 (S206).

10 [0073]

The PC 28 monitors receipt of the instruction for seal handling, the instruction for seal handling training, and reports of acceptance notifications thereof (S207). If the PC 28 receives the instruction for seal handling, the instruction for seal handling training, and the reports of acceptance notifications thereof (S207:YES), the PC 28 starts the selection of a sealing material necessary for seal handling is started in response (S208). The PC 28 notifies the PCs 24, 26 of this start. On the condition of this start of selection, the training server 30 executes a sealing material selection program (S209). The PC 28 determines whether the selection of the sealing material is completed (S210), and if the selection of the sealing material is completed (S210:YES), the PC 28 receives a sealing material selection result provided from the training server 30 and reports the sealing material selection result to the PCs 24, 26 (S211).

25 [0074]

In response to the report of the selection result, the procurement instruction for the sealing material is issued from the PC 24 to the PC 26, and the procurement instruction for the sealing material is reported to the PC 28 (S212).

30 [0075]

A start notification of the seal handling training program is issued from the PC 28 to the PCs 24, 26 (S213). The seal handling training program is executed in the training server 30 (S214). A

worker in charge of the seal handling of the sealing contractor
6 may participate in the training program.

[0076]

5 The PC 28 monitors the execution of the seal handling training
program (S215), and when the seal handling training program is
completed (S215:YES), a completion notification of the seal
handling training program is issued from the PC 28 to the PCs 24,
26 (S216). In response, a training attendance report is issued from
the PC 26 to the PCs 24, 28 (S217). At this point, if the contractor
10 6 has completed the procurement of the sealing material, a sealing
material procurement report is issued from the PC 26 to the PCs
24, 28 (S218). The sealing material procurement report may be
issued before completion of the sealing material training program.

[0077]

15 An instruction for permission of the seal handling is issued
from the PC 24 to the PC 26 at least on the condition of the seal
handling training, and the PC 28 is notified of the instruction
for permission of the seal handling from the PC 24 (S219). This
permission of the seal handling is given at least on the condition
20 of participation in the seal handling training program. The PC 26
receiving the instruction for permission of the seal handling issues
a seal handling start notification to the PCs 24, 28 (S220). The
PC 26 monitors the seal handling (S221), and when the seal handling
is completed (S221:YES), a seal handling completion notification
25 is issued from the PC 26 to the PCs 24, 28 (S222).

[0078]

The PC 28 decides whether the support is to be continued (S223).
If the support is to be continued (S223:YES), the PC 28 issues a
support continuation notification to the PCs 24, 26 (S224). If the
30 support is not continued (S223:NO), a support termination
notification is issued from the PC 28 to the PCs 24, 26 (S225).

[0079]

<Sealing Material Selection System>

[0080]

The sealing material selection system is implemented by using a sealing material database storing sealing material data of gaskets etc. correlated with use conditions. For example, a sealing material data table 35 shown in Fig. 6 is used as the sealing material database.

[0081]

The sealing material data table 35 stores a gasket group 36 including multiple gaskets and condition information identifying a gasket such as operating temperature, operating pressure, operating fluid, flange shape, device used, and other information, as use conditions 38 corresponding to the gaskets.

[0082]

By selecting two or more conditions selected from the use conditions, a recommended gasket can be selected, and by selecting a gasket, the use conditions thereof can be retrieved.

[0083]

For the sealing material selection, for example, an input screen 40 for sealing material selection shown in A of Fig. 7 is used. This input screen 40 includes a title portion 42 indicative of selection of sealing material, selection portions 44, 46, 48, 50, 52 of, for example, five use conditions, i.e., operating temperature, operating pressure, operating fluid, flange shape, and device used, and a search start button 54. By checking selection buttons 56 of the selection portions 44, 46, 48, 50, 52, the operating temperature, the operating pressure, etc. to be selected are sequentially displayed. By checking the selection buttons 56 with a displayed value etc., desired data can be input. By checking the search start button 54, a transition to a sealing material selection output screen 60 as shown in B of Fig. 7 is made.

[0084]

As shown in B of Fig. 7, a title portion 62 indicative of a selection result of sealing material, and "Selection 1", "Selection 2", etc. as multiple selection results are displayed in this output screen 60. The selection results are displayed as gasket

information 64-1, 64-2, etc. including a product number, use conditions, etc. The output screen 60 includes a back button 66, and by checking this back button 66, a transition to the input screen 40 shown in A of Fig. 7 can be made.

5 [0085]

Fig. 8 shows a process procedure of sealing material selection. This process procedure can be executed by selecting the sealing material selection program from the seal handling management system, and the input screen 40 for sealing material selection is displayed to input the use conditions from this input screen 40 (S301). After input of the use conditions, a sealing material selection process is executed with a search instruction (S302). In this sealing material selection process, the sealing material data table 35 of the database (DB) 68 is referenced.

15 [0086]

If the use conditions match the input conditions, a gasket is selected as the sealing material meeting the use conditions (S303).

[0087]

20 For the selected gasket, the gasket information such as the use conditions described above is output and displayed on the output screen 60 (S304), and the selection process is terminated.

[0088]

<Seal Handling Training System 34>

25 [0089]

A seal handling training system 34 includes a lecture style lecture system 34-1 and a practical training type practical training system 34-2 using multiple practical training equipments.

[0090]

30 As shown in Fig. 9, the lecture system 34-1 includes multiple PCs 70 in a first training room 69-1. The PCs 70 are connected to the training server 30 through a network 72 and can give and receive information. The network 72 may be either wired or wireless.

[0091]

Each of the PCs 70 includes a monitor 74 and an input apparatus 76. The monitor 74 may include a touch panel on a display screen to enable touch input. The input apparatus 76 includes a keyboard and a mouse and may include a barcode reader.

5 [0092]

Trainees 78 are persons in charge of seal handling such as employees of the contractor 6. In this case, an instructor may use any of the PCs 70 to explain contents of a teaching material.

[0093]

10 According to the lecture system 34-1 as described above, the trainees 78 gathering in the training room 69-1 can learn from a common lecture training material developed on the monitors 74 of the PCs 70. In some cases, the network 72 can be opened to the Internet 32 for performing supplementary lectures through
15 e-learning, for example.

[0094]

As shown in Fig. 10, the practical training system 34-2 includes multiple practical training equipments, such as a flange tightening practical training equipment 80-1, a creep relaxation
20 practical training equipment 80-2, a sealability practical training equipment 80-3, as examples of the seal handling means. The flange tightening equipment 80-1, the creep relaxation practical training equipment 80-2, and the sealability practical training equipment 80-3 are disposed in a second training room 69-2 and individually
25 include PCs 82. The PCs 82 are connected to the training server 30 through the network 72 and can give and receive information. Although this embodiment includes the first and second training rooms 69-1, 69-2, a single training room may be included, or three or more training rooms may be included so that the equipment is
30 disposed in a distributed manner.

[0095]

Each of the PCs 82 is provided with a data logger 84 and a monitor 86. The data logger 84 takes a sensor output from a sensor on the apparatus body side and inputs the sensor output to the

corresponding PC 82. The monitor 86 may include a touch panel on a display screen to enable touch input. The input apparatus includes a keyboard and a mouse and may include a barcode reader.
[0096]

5 According to the practical training system 34-2 as described above, the trainees 78 can receive support from an instructor of seal handling and can take training under the same operating conditions as a seal handling device.

[0097]

10 <Hardware of the PCs 24, 26, 28, 70, 82>

[0098]

For the PCs 24, 26, 28, 70, 82, a PC 90 shown in A of Fig. 11 may be used. The PC 90 includes a processor 92, a storage unit 94, an input/output unit (I/O) 96, an operation input unit 98, and
15 a communication unit 100. The I/O 96 connects to a monitor 102.

[0099]

The processor 92 executes various programs such as an OS (Operating System), a support program, a seal handling program, the seal handling training program, and the sealing material
20 selection program in the storage unit 94, and performs information processing such as arithmetic processing, and control of various functional units. The storage unit 94 includes recording mediums such as a ROM (read-only memory) and a RAM (random-access memory). The recording mediums may be a hard disk, a semiconductor memory,
25 a DVD (digital versatile disk), etc. In addition to the OS, various programs such as the seal handling program, the seal handling training program, and the sealing material selection program are stored in the storage unit 94. The RAM constitutes a work area for the information processing.

30 [0100]

The operation input unit 98 is used for information input under the control of the processor 92. The operation input unit 98 includes an information input device such as a keyboard, a mouse, a touch panel, and a barcode input unit.

[0101]

The communication unit 100 is connected to the network 72 wirelessly through Wi-Fi (Wireless Fidelity) etc. The monitor 102 is an example of an information presentation means and is used as the monitors 74, 86 etc. described above.

[0102]

<Hardware of the Training Server 30>

[0103]

The training server 30 includes a processor 104, a storage unit 106, an I/O 108, and a communication unit 110 as shown in B of Fig. 11.

[0104]

The processor 104 executes an OS and a training program in the storage unit 106. The I/O 108 is used for information input. The communication unit 110 communicates with the PC 90 described above through the network 72.

[0105]

The storage unit 106 includes recording mediums such as a ROM and a RAM, and the recording mediums may be a hard disk, a semiconductor memory, a DVD, etc. In addition to the OS, various programs such as the seal handling training program are stored in the storage unit 106. The RAM constitutes a work area for the information processing. The database 68 used for the seal handling training program is stored in the storage unit 106

[0106]

<Seal Handling Training Information Table 112>

[0107]

As shown in Fig. 12, a seal handling training information table 112 stores categories 114, large items 116, middle items 118, and small items 120. The categories 114 include broadly classified information such as personnel information 114-1, sealing information 114-2, seal handling information 114-3, training information 114-4, and related information 114-5. The personnel information 114-1 includes administrator information and worker

information. The sealing information 114-2 includes sealing material information, and the seal handling information 114-3 includes seal handling device information, seal handling tools, seal handling request information, etc. The training information 114-4 includes a seal handling training program etc. The related information 114-5 includes policy, standard information, analysis information, investigation information, support information, statistical information, etc.

[0108]

As shown in A of Fig. 13, a personnel information table 122 stores the personnel information 114-1. The personnel information 114-1 stores the administrator information identifying an administrator managing the seal handling, and the worker information identifying a worker of the contractor 6 in charge of the seal handling. The administrator information stores a department, a job, and a name. By referring to the personnel information table 122, a participant in a training program can be identified and confirmed in terms of an assigned job etc.

[0109]

The worker information includes a company name, a department, a job, a name, and a skill. The skill is stored as a seal handling skill level of a worker. The skill may be determined by a skill determination program. Thus, by referring to the personnel information table 122, a worker can be identified and confirmed in terms of an assigned job, the skill, i.e., a seal handling skill level, etc.

[0110]

As shown in B of Fig. 13, a sealing material information/seal handling information table 124 stores sealing material information identifying a sealing material and stores a product name and dimensions. The product name is stored as identification information such as a symbol identifying a manufacturer and a specific name. The dimensions are stored as shape dimensions, thickness, etc. of the sealing material.

[0111]

The seal handling device information is stored as information identifying seal handling devices that are objects of the seal handling, and the seal handling device information as the middle items 118 is stored as a flange, bolt/nut, fluid, pressure, and temperature. The small items 120 stored for the flange are a shape, a standard (dimensions), and a material identifying the flange. The small items 120 stored for the bolt/nut are dimensions and a material identifying the bolt/nut. For the fluid, a type of the fluid used in the seal handling device is stored. For the pressure, the pressure of the fluid used in the seal handling device is stored. For the temperature, the temperature used for the seal handling device is stored.

[0112]

For the seal handling tools, a tightening tool and a flange tool are stored as the middle items 118 for the seal handling tools used for the seal handling. The small items 120 for the tightening tool include a hand spanner, a manual torque wrench, a booster wrench, an air torque wrench, a hydraulic torque wrench, a bolt tensioner, an ultrasonic axial force meter, etc. The small items 120 for the flange tool include a flange spreader, a flange opener, and a flange closer.

[0113]

The seal handling request information is stored as information indicative of important matters requested for the seal handling, and the seal handling request information as the middle items 118 is stored as storage, a transportation method, an installation method, bolt/nut, a tightening force, and a tightening procedure. The small item 120 stored for the storage is the place thereof; the small items 120 stored for the transportation method is the means thereof; the small items 120 stored for the installation method are a flange tool used and flange surface confirmation; and the small items 120 stored for the bolt/nut are maintenance, a lubricant type, replacement, material, and dimensions. The small

items 120 stored for the tightening force are a torque and an axial force.

[0114]

A training information table 126 stores training information of the seal handling training, and as shown in A of Fig. 14, the training information as the middle items 118 is stored as a tightening method, a stress relaxation, sealability, compression failure, surface pressure distribution, and two types of site flange seal handling. The small items 120 including to the tightening method are a flange tightening practical training equipment and a torque feeling practical training equipment. The small item 120 including to the stress relaxation is a creep relaxation practical training equipment. The small item 120 including to the sealability is a sealability practical training equipment. The small item 120 including to the compression failure is a compression failure practical training equipment. The small item including to the surface pressure distribution is a bolt influence practical training equipment. The small item 120 including to one of the site flange seal handling is a site simulation tightening practical training equipment, and the small item 120 including to the other site flange seal handling is a piping alignment practical training equipment.

[0115]

As shown in B of Fig. 14, a related information table 128 stores related information to be utilized for the seal handling training. The middle items 118 include safety and security measures for the policy; for example, qualification certification system standard for the standard information; accident cause and analysis for the analysis information; leakage cause investigation result for the investigation information; and support center information for the support information.

[0116]

<Course Curriculum Table 130>

[0117]

As shown in Fig. 15, a course curriculum table 130 stores courses 132, curriculums 134, curriculum contents 136, and hours 138. The courses 132 include a basic course 130-1, an advanced course 130-2, and a custom course 130-3. The curriculums 134 include lecture programs and practical training programs, and the lecture programs or the practical training programs include basic programs and applied programs. For each of the lecture programs and the practical training programs, "lecture (basic)", "lecture (applied)", "practical training (basic)", or "practical training (applied)" is stored as identification information representative of whether the program is the basic program or the applied program. For the curriculum contents 136, items indicating contents to be learned are stored. For the hours 138, numerical values representative of a learning time or a practical training time are stored.

[0118]

<Gasket's Lecture Contents Table 140>

[0119]

As shown in A of Fig. 16, a gasket's lecture contents table 140 stores curriculums 142, levels 144, and contents 146. For the curriculums 142, items representative of multiple curriculums are stored. For the levels 144, "basic" or "applied" representative of a basic program or an applied program is stored. For the contents 146, learning contents are stored for each level of the curriculums 142.

[0120]

<Gasket's Practical Training Contents Table 148>

[0121]

As shown in B of Fig. 16, a gasket's practical training contents table 148 stores curriculums 150, levels 152, contents 154, and practical training equipments 156. For the curriculums 150, items representative of multiple curriculums are stored. For the levels 152, "basic" or "applied" representative of a basic program or an applied program is stored. For the contents 154,

learning contents are stored for each item of the curriculums 150. For the practical training equipments 156, the practical training equipments corresponding to the curriculums 150 are clearly indicated as the practical training equipments used for learning of the contents of the curriculums 150, for example, the "flange tightening practical training equipment" and the "torque feeling practical training equipment" used for the "tightening method".

[0122]

<Gland Packing's Lecture Contents Table 158>

10 [0123]

As shown in A of Fig. 17, a gland packing's lecture contents table 158 stores curriculums 160 and contents 162. For the curriculums 160, items representative of multiple curriculums are stored. For the contents 162, learning contents are stored for each item of the curriculums 160.

[0124]

<Gland Packing's practical training contents table 164>

[0125]

As shown in B of Fig. 17, a Gland Packing's practical training contents table 164 stores curriculums 166, outlines 168, and practical training equipments 170. For the curriculums 166, items representative of multiple curriculums are stored. For the outlines 168, learning contents are stored for each item of the curriculums 166. The practical training equipments 170 include, for example, an "actual valve gland packing practical training equipment" and an "actual rotary pump gland packing practical training equipment" as practical training equipments used for learning the contents of the curriculum 166.

[0126]

30 <Lecture Contents Table 172>

[0127]

As shown in Fig. 18, a lecture contents table 172 includes learning items 174, learning contents 176, and the skills 178 as items. The learning items 174 present multiple items of learning

contents. The learning contents 176 present purposes and outlines of the learning contents included in the learning items 174. The skills 178 indicate importance of selection for jobs and newcomers with "circles" or "double circles". The "circles" mean "necessary", or the "double circles" mean "extremely important".

[0128]

<Practical Training Contents table 180>

[0129]

As shown in Fig. 19, a practical training contents table 180 includes practical training items 182, practical training contents 184, skills 186, and equipment name 188. The practical training items 182 present multiple items summarizing the practical training contents 184. The practical training contents 184 present purposes and outlines of the practical training contents included in the practical training items 182. The skills 186 indicate importance of selection for jobs and newcomers with "circles" or "double circles". The "circles" mean "necessary", or the "double circles" mean "extremely important". For the equipment name 188, the corresponding practical training equipments are clearly specified.

[0130]

<Training Input Screen 190>

[0131]

A training input screen 190 is used for the training program. As shown in A of Fig. 20, the training input screen 190 includes a title portion 192 representative of trainee information input, a company name input portion 194, a department name input portion 196, a name input portion 198, a skill input portion 200, and an attendance place input portion 201. The skill input portion 200 includes a selection button 202, and a selected skill can be determined by checking the selection button 202. A decision button 204 is included in a lower field of the training input screen 190. By checking the decision button 204, the input trainee information can be determined.

[0132]

<Training Output Screen 206>

[0133]

When the training program is completed, a training output screen 206 is developed. As shown in B of Fig. 20, a title portion 208 representative of training completion data and a training content display portion 210 are displayed on the training output screen 206. A name 210-1, a department name 210-2, a completed course name 210-3, an evaluation 210-4, and other related information 210-5 are displayed in the training content display portion 210.

[0134]

<Process Procedure of Seal Handling Training>

[0135]

Fig. 21 shows a process procedure of the seal handling training. This process procedure is an example of the seal handling training program or a seal handling training method.

[0136]

In the process procedure of the seal handling training, it is determined whether a training or not so as to confirm an intention of a trainee from a training screen of a PC (S401). Upon shifting to the training (S401:YES), it is confirmed whether the importance of sealing material selection is recognized (S402). If the importance of sealing material selection is not recognized (S402:NO), a training for sealing material selection is imposed (S403). The training for sealing material selection is performed as relearning of the lecture. The confirmation of recognition of sealing material selection is intended to allow one to recognize the sealing material used in the actual seal handling so that the training of the seal handling is performed on the premise of the recognition to improve a training effect. After the training of sealing material selection (S403) is completed, the procedure returns to S402.

[0137]

If the importance of sealing material selection is recognized

(S402:YES), a trainee's skill is determined (S404). This skill determination is performed according to a skill determination process procedure (Fig. 22).

[0138]

5 After the skill determination, a training course is selected (S405). This course selection is performed according to a course selection process procedure (Fig. 23).

[0139]

10 After the course selection, an intention for the training is confirmed (S406), and the training is started (S406:YES) to first perform a training with a lecture program (S407). This lecture program is performed by the lecture system 34-1 and terminated after a predetermined subject and time. In this case, re-learning is required depending on an evaluation.

15 [0140]

 When the lecture program is completed (S408:YES), the procedure goes to the practical training program (S409). This practical training program is performed by the practical training system 34-2, and a equipment is selected according to a predetermined subject and time so that the necessary training is performed. In this case, an evaluation is made based on sensor output and input information based on the training, and re-learning is required depending on the evaluation.

[0141]

25 When the practical training program is completed (S410:YES), the seal handling training program is completed, and a completion display is presented (S411).

[0142]

<Process Procedure of Skill Determination>

30 [0143]

 Fig. 22 shows a process procedure of the skill determination. When the procedure is shifted to the process procedure of the skill determination, it is determined whether or not the trainee is a newcomer or a general person (S501). This process is performed

according to input information of the trainee. The "newcomer" is a person related to seal handling and having no experience or substantially no experience of seal handling. The "general person" is assumed as a general person such as a student desired to have knowledge of seal handling.

[0144]

If the trainee is a newcomer or a general person (S501:YES), Skill 1 is selected (S502), the procedure returns to S404 of the seal handling training program (Fig. 21).

[0145]

If the trainee is not a newcomer or general (S501:NO), the procedure goes to skill information input (S503). In the skill information input, information necessary for skill determination is input, and skill determination is performed based on this information input (S504). Depending on this skill determination, a skill is assigned any of Skill 2, Skill 3,... Skill N from multiple skills (S505). In this example, the trainees are categorized into N stages from the lowest Skill 1 to the highest Skill N, and the procedure returns to S404 of the seal handling training program (Fig. 21). The skill stages are divided into any number of stages such as 2, 3, 4, and 5.

[0146]

<Process Procedure of Course Determination>

[0147]

Fig. 23 shows a process procedure of the course selection. When the procedure is shifted to the process procedure of the course selection, it is determined whether or not the trainee is a newcomer or a general person (S601). This process may be performed as described above according to the input information of the trainee.

[0148]

If the trainee is a newcomer or a general person (S601:YES), the basic course is selected (S602), and the procedure returns to S405 of the seal handling training program (Fig. 21).

[0149]

If the trainee is not a newcomer or general (S601:NO), it is determined whether the course is a custom course (S603). If the course is not a custom course (S603:NO), a trainee's job type is determined (S604). Based on the job type determination, any of
 5 Advanced Course 1, Advanced Course 2 ... Advanced Course N is selected from multiple advanced courses (S605).

[0150]

If the course is a custom course (S603:YES), a trainee's job type is determined (S606). Based on the job type determination,
 10 any of Custom Course 1, Custom Course 2 ... Custom Course N is selected from multiple custom courses (S607).

[0151]

<Lecture Program>

[0152]

15 The lecture program includes basic courses, advanced courses, and custom courses, and lectures for the lecture are delivered according to the respective courses.

[0153]

In gland packing's lecture, a lecture on gland packing is
 20 delivered.

[0154]

<Practical Training Program>

[0155]

The program includes basic courses, advanced courses, and
 25 custom courses, and practical trainings are conducted according to the respective courses. The practical trainings are conducted by using multiple practical training devices for simulating actual sites, such as a flange tightening practical training equipment, a sealability practical training equipment, a creep relaxation
 30 practical training equipment, a torque feeling practical training equipment, a piping alignment practical training equipment, a site simulation tightening practical training equipment, a compression failure practical training equipment, and a heat exchanger practical training equipment. Based on execution of the training

program, a necessary device is selected from these devices.

[0156]

In gland packing practical training, an actual rotary pump gland packing practical training equipment and an actual valve gland packing practical training equipment are used.

[0157]

<System, Method, and Program of Seal Handling Training>

[0158]

This seal handling training system includes process procedures of a device selection step (S701), a sensor output or training information acquisition step (S702), a simulation information generation step (S703), and a simulation information presentation step (S704) as shown in Fig. 24 as a seal handling training method with a computer, for example.

[0159]

At the device selection step (S701), a device required for the training is selected from the flange tightening practical training equipment 80-1, the creep relaxation practical training equipment 80-2, the sealability practical training equipment 80-3, etc. disposed in the training room 69-2 that is an example of one or more training rooms. In addition to the devices described above, the devices may include a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger.

[0160]

At the sensor output or training information acquisition step (S702), the training information is acquired from a sensor output of a sensor included in each of the seal handling devices or an input means.

[0161]

At the simulation information generation step (S703), simulation information related to a device included in the seal

handling devices is generated with the acquired sensor output or the acquired training information.

[0162]

At the simulation information presentation step (S704), the simulation information is presented as either or both of character information and graphic information. For this presentation of information, the information presentation means such as the monitor 86 is used.

[0163]

In this seal handling training system, a seal handling device disposed in the training room 69-2 (Fig. 10) may be a device including a sensor for detecting a tightening axial force or a device without a sensor. For the device without a sensor, a keyboard or an information processing terminal is used as a training information input means.

[0164]

An information processing device such as the PC 82 described above is used as the processing means. The processing means acquires the sensor output or the training information, and generates the simulation information related to a device included in the seal handling means. For this processing means, for example, the monitor 86 is used as the wired or wirelessly connected information presentation means. This information presentation means presents a process output from the processing means in a display form of either or both of character information and graphic information.

[0165]

The seal handling training program executed by this processing means is stored in the storage unit 106 of the training server 30 described above and is executed at the time of training. This seal handling training program has a function for executing the training process program as in the process procedure of the seal handling training method described above. This function includes a device selection function, a sensor output or training

information acquisition function, a simulation information generation function, and a simulation information presentation function. The device selection function includes, for example, a function of selectin a device required for the training from the seal handling devices including a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger. The simulation information generation function includes a function of generating simulation information related to a device included in the seal handling devices with the acquired sensor output or the acquired training information, and the simulation information presentation function includes a function of presenting the simulation information as either or both of character information and graphic information.

[0166]

<Effects of Second Embodiment>

[0167]

According to the second embodiment, the following effects can be obtained.

[0168]

(1) In response to the issuance of seal handling promotion issued from the PC 28 and the seal handling instruction issued from the PC 24, the sealing material selection, the sealing material procurement, and the seal handling training can be unified, so that the seal handling can be made highly precise and more efficient.

[0169]

(2) In response to the seal handling instruction from the PC 24, the contractor 6 can receive the seal handling training at the support center 8, can procure a currently required sealing material for the seal handling from the support center 8, and can practice the training for the sealing material.

[0170]

(3) The client 4 instructs the contractor 6 to purchase the sealing material selected by the support center 8. As a result, the sealing material conforming to the seal handling object is selected. Thus, the reliability of the selected sealing material can be ensured.

[0171]

(4) The contractor 6 having received the seal handling training at the support center 8 can perform the seal handling on the seal handling object with the sealing material related to the selection of the support center 8. As a result, the seal handling can be made highly precise and increased in reliability.

Example 1

[0172]

A of Fig. 25 shows the flange tightening practical training equipment 80-1 according to Example 1. The flange tightening practical training equipment 80-1 includes a first seal handling portion 224-1 and a second seal handling portion 224-2 in an equipment's main part 222, includes flange joints having different diameters in the seal handling portions 224-1, 224-2 with gaskets 228-1, 228-2 sandwiched between flanges 226, and includes pluralities of bolts 230 and nuts 232. The trainee successively tightens the nuts 232 with, for example, a torque wrench as a seal handling tool to perform a seal handling.

[0173]

Each of the bolts 230 includes a strain sensor 234 as shown in B of Fig. 25. The strain sensor 234 detects an axial force generated in the bolt 230 from a tightening torque τ of the nut 232.

[0174]

This sensor output is taken into the PC 82 through the data logger 84 (Fig. 10). The PC 82 displays axial forces during the tightening on the monitor 86 with a polygonal figure showing amplitudes of the axial forces as a distance from the center in real time.

[0175]

The practical training using this flange tightening practical training equipment 80-1 allows the trainee to recognize variations in tightening with the seal handling tool, a relationship between a tightening force and an axial force of an adjacent bolt due to elastic interaction and occurrence of uneven tightening due to an inappropriate tightening procedure, and allows the trainee to learn important matters such as the tightening force and the tightening procedure for implementing a gasket function. A result of this training is stored in the seal handling training information table 112 in correlation with the trainee.

Example 2

[0176]

A of Fig. 26 shows the creep relaxation practical training equipment 80-2 according to Example 2. In A of Fig. 26, the common portions with Fig. 25 are denoted by the same reference signs. In this creep relaxation practical training equipment 80-2, heaters 236-1, 236-2 are respectively disposed in piping portions 235 sandwiching a seal handling portion 224-3. The heaters 236-1, 236-2 may be heat-transfer heaters.

[0177]

The gasket 228 is sandwiched between the flanges 226, and the pluralities of the bolts 230 and the nuts 232 are included. Each of the bolts 230 includes the strain sensor 234 as shown in B of Fig. 26.

[0178]

In the practical training of creep relaxation, operation forms such as high-temperature operation and cycle operation are simulated as operating conditions for gaskets of different materials, and a change in axial force after tightening is detected by each of the strain sensors 234. The high-speed operation and the cycle operation may be simulated by changing temperature through temperature control of the heaters 236-1, 236-2.

[0179]

This creep relaxation practical training equipment 80-2 detects a post-tightening reduction in surface pressure, which cannot be seen in an actual device, as a change in axial force in real time, and displays this change in axial force. This allows the trainee to recognize the reduction in surface pressure and to learn an initial tightening force and effective timing of retightening.

Example 3

[0180]

Fig. 27 shows the sealability practical training equipment 80-3 according to Example 3. In Fig. 27, the common portions with Fig. 25 are denoted by the same reference signs. The sealability practical training equipment 80-3 includes the first seal handling portion 224-1 and the second seal handling portion 224-2 in the equipment's main part 222 with gaskets 228 sandwiched between the flanges 226 and includes the pluralities of the bolts 230 and the nuts 232.

[0181]

The flange 226 on the closing side on the top side of the equipment's main part 222 is provided with a pressurizing apparatus 238 pressurizing the inside of the equipment's main part 222 along with a pressure sensor 239 detecting the pressure in the equipment's main part 222. The pressure sensor 239 detects a change in pressure due to sealing deterioration of the seal handling portions 224-1, 224-2.

[0182]

The sealability of the seal handling portions 224-1, 224-2 is affected by the flanges 226, the gaskets 228, and the bolts 230. The sealability of the gaskets 228 is affected by surface flaws, surface roughness, and corrosion on the flanges 226; surface flaws and adhesion of foreign matters such as sand dusts on the gaskets 228; and rust and lubricant in a bolted state.

[0183]

This sealability practical training equipment 80-3 can

reproduce troubles due to the states of the flanges 226, the gaskets 228 or the bolts 230 to allow the trainee to learn a technique of leak check.

Example 4

5 [0184]

Fig. 28 shows the site simulation tightening practical training equipment 80-4 according to Example 4. In Fig. 28, the common portions with Fig. 25 are denoted by the same reference signs. This site simulation tightening practical training equipment 80-4
10 simulates a seal handling site under poor conditions in seal handling operation to allow the trainee to learn the seal handling.
[0185]

At seal handling sites, workers must perform seal handlings under poor conditions due to high places, narrow places, obstacles,
15 etc. In addition to high places, for example, complicated arrangement of pipes, racks, structures, devices, etc. forms narrow spaces etc. As shown in A of Fig. 28, multiple pipes 240-1, 240-2, 240-3 may be adjacent to each other so that the seal handling portions, i.e., flange joints 242-1, 242-2, 242-3, are adjacent
20 to each other. As shown in B of Fig. 28, multiple pipes 240-4, 240-5 may adjacently cross each other so that the seal handling portions, i.e., flange joints 242-4, 242-5 are adjacent to each other in the crossing portion. As shown in C of Fig. 28, a pipe 240-6 may be disposed adjacent to a structure 244 so that a flange joint 242-6
25 is adjacent to the structure 244. Assuming a site situation of such a seal handling, the site simulation tightening practical training equipment 80-4 freely reproduces the assumed seal handling site such as a high place, a narrow place, an obstacle, and allows the trainee to learn the seal handling under poor conditions hindering
30 workability.

Example 5

[0186]

Fig. 29 shows a piping alignment practical training equipment 80-5 according to Example 5. In Fig. 29, the common portions with

Fig. 25 are denoted by the same reference signs. In the sites of seal handlings, workers encounter the cases that an interval between the flanges 226 of pipes 240-11, 240-12 to be connected is wide as shown in A of Fig. 29, that an interval between the flanges 226 of the pipes 240-11, 240-12 is narrow as shown in B of Fig. 29, that parallelism cannot be achieved due to inclination between the flanges 226 of the pipes 240-11, 240-12 as shown in C of Fig. 29, that centers are displaced between the flanges 226 of the pipes 240-11, 240-12 as shown in D of Fig. 29, etc. In such a situation, even if tightening is performed at a uniform tightening force, the tightening force cannot properly be transmitted to the gasket 228. This piping alignment practical training equipment 80-5 reproduce actual misalignment by freely setting the gap, inclination, misalignment, etc. to allow the trainee to practice the seal handling for solving the misalignment. In terms of these situations, the situation of tightening (surface pressure) by the trainee is evaluated.

Example 6

[0187]

Heat exchangers have a structure more complicated than general tube-coupling flanges, and it is required to understand the structure thereof for performing the seal handling. Two gaskets on a fixed tube plate are sandwiched and tightened between flanges, so that uneven tightening tends to easily occur.

large-diameter flanges are accompanied with a large number of bolts and cause a non-negligible reduction in tightening force between adjacent bolts during tightening due to the elastic interaction between the flanges. Regarding a partition plate, if the centers are displaced between tube flange/shell flange, the partition plate does not enter a groove and may inconveniently ride thereon. Such special structures, optimum tightening force, and appropriate seal handling tool selection and tightening procedure are required.

[0188]

In this heat exchanger practical training equipment, the heat

exchanger is disassembled, and the trainee is allowed to practice the bolt tightening of the fixed tube plate, centering of the tube flange/shell flange, etc. necessary for the seal handling as if an actual device is used.

5 Example 7

[0189]

The compression failure practical training equipment allows the trainee to learn compression failure etc. of a gasket due to excessive tightening etc. Regarding compression failure, the
10 apparatus reproduces a situation in which compression failure easily occurs in terms of a type of a gasket, paste application, a small diameter flange, etc., and allows the trainee to learn causes of leakage and prevention thereof. For example, the compression failure is likely to occur in an expanded graphite sheet gasket
15 since a compression failure surface pressure is lower than other gaskets, in the paste application since the compression failure easily occurs although sealability is improved, and in the small diameter flange since a gasket area is small relative to the number of bolts so that the surface pressure tends to be high.

20 [0190]

Thus, regarding the compression failure causing leakage, this compression failure practical training equipment can allow the trainee to learn a relationship among a type of a gasket, the presence/absence of paste, the crack deformation and the crack
25 causing the compression failure, etc.

Example 8

[0191]

In other examples, the torque feeling practical training equipment, the actual rotary pump gland packing practical training
30 equipment, and the actual valve gland packing practical training equipment are used. The torque feeling practical training equipment can allow the trainee to experience a transition in tightening torque and axial force with respect to pluralities of bolts and nuts having different tightening conditions.

[0192]

[Other Embodiments]

[0193]

(1) Transportable practical training equipment: The seal
5 handling system and the seal handling management system of the
embodiments are not limited to stationary training equipment. The
equipment may be transportable practical training equipment
enabling a lecture at a client's conference room, training center,
etc. to achieve the seal handling with enhanced client's convenience.
10 This transportable practical training equipment may include, for
example, a transportable base capable of saving the space required
for the lecture, and a number of pieces of the practical training
equipment such as flange tightening practical training equipment
and torque feeling practical training equipment may be disposed
15 on the transportable base. The weight and size may be set such that
each piece of the equipment can be moved with a hand cart.

[0194]

For example, as shown in Fig. 30, such pieces of transportable
practical training equipment can be tabulated in a training table
20 246 to enable selection of an equipment name 248, selection of
basic/applied 250, a practical training name 252, practical
training contents 254, and program availability 256, and the seal
handling can thereby be implemented as needed based on budget etc.

[0195]

25 (2) Acquisition of sealing material information: In the first
and second embodiments, the selection of the sealing material is
a condition of permission for the seal handling; however,
acquisition of sealing material information may be a condition of
permission for the seal handling. In the first embodiment, as shown
30 in Fig. 31, the support center 8 may receive the issuance of the
sealing material selection instruction from the client 4 (S104),
acquire the sealing material information (S112), and transmit the
acquisition result to the client 4 and the contractor 6 (S113).
In the second embodiment, as shown in Fig. 32, once the PC 28 receives

the issuance of the sealing material selection instruction from the PC 24 (S206), the sealing material information may be acquired (S226), and the PC 24 and the PC 26 may be notified of the acquisition result (S227). Such a process is convenient since the sealing material information can be acquired without selecting a sealing material and the client 4 and the contractor 6 can acquire the necessary sealing material to perform the seal handling.

[0196]

(3) Sealing material selection of the training program: The process shown in Fig. 21 has the process procedure of confirming the recognition of the importance of the sealing material selection (S402) and performing the training of the sealing material selection (S403). However, the process is not limited thereto. For example, as shown in Fig. 33, the process procedure may include determining whether a sealing material is selected (S412) in response to the start of the training, selecting a sealing material (S413) if a sealing material is not selected (S412:NO), and shifting to the skill determination (S404) on condition that the sealing material is selected.

[0197]

(4) Information input: On the training input screen 190 used for information input, the trainee information is inputted as shown in A of Fig. 20; however, the information input is not limited thereto. For example, as shown in Fig. 34, in addition to an input portion 191 for inputting affiliation and person-in-charge information, details of lecture contents 193 may be prepared in advance in terms of the number of days, the number of persons, the attendance place, the course, etc., to allow one to check a check box and select information. For inputting other pieces of information, input of a special notation 195 may be enabled.

[0198]

(5) Processing of practical training equipment and acquired information: The practical training equipments used in the embodiments includes both practical training equipments including

a sensor for detecting an axial force of a bolt etc. and practical training equipments without a sensor. In the practical training equipments without a sensor, the information input means related to a practical training may be implemented by inputting information to a PC, and simulation information may be generated from the related information.

[0199]

(6) Sealing material and seal handling thereof: In the embodiments, a gasket is exemplified as a sealing material; however, other sealing materials may be used. The seal handling includes not only the usage aspect of the sealing material but also aspects including design and manufacturing.

[0200]

As described above, the most preferable embodiments and examples of the present invention have been described. The present invention is not limited to the above description. Various modifications and changes can be made by those skilled in the art based on the spirit of the invention described in claims or disclosed in description of embodiments or examples. Such modifications and changes obviously fall within the scope of the present invention.

INDUSTRIAL APPLICABILITY

[0201]

According to the present invention, a client PC, a contractor PC, and a support center PC can be linked to implement unified management of the seal handling training for the contractor, and the selection and purchase of the sealing material. The accuracy of the seal handling is then increased and the reliability is improved.

REFERENCE SIGNS LIST

[0202]

2 seal handling system

4 client

6 contractor

	8	support center
	20	seal handling management system
	24, 26, 28	PC
	30	training server
5	32	internet
	34	seal handling training system
	34-1	lecture system
	34-2	practical training system
	35	sealing material data table
10	36	gasket group
	38	use conditions
	40	input screen
	42	title portion
	44, 46, 48, 50, 52	selection portion
15	54	search start button
	56	selection button
	60	output screen
	62	title portion
	64-1, 64-2...	gasket information
20	66	back button
	68	database
	69-1, 69-2	training room
	70	PC
	72	network
25	74	monitor
	76	input apparatus
	78	trainee
	80-1	flange tightening practical training equipment
	80-2	creep relaxation practical training equipment
30	80-3	sealability practical training equipment
	80-4	site simulation tightening practical training equipment
	80-5	piping alignment practical training equipment
	82	PC
	84	data logger

	86	monitor
	90	PC
	92	processor
	94	storage unit
5	96	input/output unit (I/O)
	98	operation input unit
	100	communication unit
	102	monitor
	104	processor
10	106	storage unit
	108	I/O
	110	communication unit
	112	seal handling training information table
	114	categories
15	116	large items
	118	middle items
	120	small items
	114-1	personnel information
	114-2	sealing information
20	114-3	seal handling information
	114-4	training information
	114-5	related information
	122	personnel information table
	124	sealing material information/seal handling information table
25	126	training information table
	128	related information table
	130	course curriculum table
	130-1	basic course
	130-2	advanced course
30	130-3	custom course
	132	courses
	134	curriculums
	136	curriculum contents
	138	hours

	140	gasket's lecture contents table
	142	curriculumums
	144	levels
	146	contents
5	148	gasket's practical training contents table
	150	curriculumums
	152	levels
	154	contents
	156	practical training equipment
10	158	gland Packing's lecture contents table
	160	curriculumums
	162	contents
	164	gland packing's practical training contents table
	166	curriculumums
15	168	outlines
	170	practical training equipment
	172	lecture contents table
	174	learning items
	176	learning contents
20	178	skills
	180	practical training contents table
	182	practical training items
	184	practical training contents
	186	skills
25	188	equipment name
	190	training input screen
	192	title portion
	194	department name input portion
	196	job input portion
30	198	name input portion
	200	skill input portion
	202	selection button
	204	decision button
	206	training output screen

- 208 title portion
- 210 training content display portion
- 210-1 name
- 210-2 department name
- 5 210-3 completed course name
- 210-4 evaluation
- 210-5 related information
- 222 equipment's main part
- 224-1 first seal handling portion
- 10 224-2 second seal handling portion
- 224-3 seal handling portion
- 226 flange
- 228 gasket
- 228-1, 228-2 gasket
- 15 230 bolt
- 232 nut
- 234 strain sensor
- 235 piping portion
- 236-1, 236-2 heater
- 20 238 pressurizing apparatus
- 239 pressure sensor
- 240-1, 240-2, 240-3 piping
- 240-4, 240-5, 240-6 piping
- 240-11, 240-12 piping
- 25 242-1, 242-2, 242-3 flange joint
- 242-4, 242-5, 242-6 flange joint
- 244 structure
- 246 training table
- 248 equipment name
- 30 250 selection of basic/applied
- 252 practical training name
- 254 practical training contents
- 256 program availability

CLAIMS

1. A seal handling system linking a client to order a seal handling, a contractor to receive a contract for the seal handling, and a support center to support the seal handling, wherein

an instruction for receiving a seal handling training at the support center is issued from the client to the contractor, and wherein

the seal handling by the contractor is permitted on condition that the seal handling training for the contractor is received at the support center in response to the instruction for receiving the training.

2. The seal handling system according to claim 1, wherein in response to the instruction for receiving the training from the client, a sealing material necessary for the seal handling is selected or information of the sealing material is provided, and a procurement instruction for the sealing material is issued from the client to the contractor.

3. A seal handling system linking a client to order a seal handling, a contractor to receive a contract for the seal handling, and a support center to support the seal handling, wherein

an instruction for receiving a seal handling training at the support center is issued from the client to the contractor, wherein

in response to the instruction for receiving the training from the client, the seal handling training is performed for the contractor at the support center, and a sealing material necessary for the seal handling is selected or information of the sealing material is provided, and wherein

a procurement instruction for the sealing material is issued from the client to the contractor, and the seal handling is permitted on condition that the seal handling training is received.

4. A seal handling management method performed by linking a client computer, a contractor computer, and a support center computer, the method comprising:

5 a step of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center and a procurement instruction for both a sealing material and a seal handling tool or at least the sealing material; and

10 a step of, by the support center computer, managing the seal handling training and receiving an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material.

5. A seal handling management method performed by linking 15 a client computer, a contractor computer, and a support center computer, the method comprising:

a step of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing 20 material and a seal handling tool or for at least the sealing material;

a step of, by the support center computer, managing the seal handling training and receiving an instruction from the client computer to select a sealing material necessary for a seal handling 25 or acquire information of the sealing material;

a step of, by the contractor computer, notifying at least the client computer of an attendance report of the seal handling training; and

30 a step of, by the client computer, receiving the attendance report of the seal handling training from at least the contractor computer to issue permission for a seal handling using the sealing material to the contractor computer.

6. The seal handling management method according to claim

4 or 5, further comprising a step of, by the support center computer, managing at least one of the seal handling, the seal handling training, and purchase of the sealing material, the at least one being related to at least the client computer or the contractor computer.

7. The seal handling management method according to any one of claims 4 to 6, further comprising

a step of, by the support center computer, issuing a seal handling promotion to the client computer before an instruction for a seal handling from the client computer to the contractor computer.

8. The seal handling management method according to any one of claims 4 to 7, further comprising

a step of, by the support center computer, acquiring a record of the seal handling and presenting seal handling information to at least the client computer or the contractor computer.

9. The seal handling management method according to any one of claims 4 to 8, wherein

the seal handling tool includes a flange peripheral member, a tightening tool, and an information terminal storing flange tightening information.

25

10. A seal handling management system comprising: a client computer; a contractor computer; and a support center computer in a linked manner, wherein

an instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing material and a seal handling tool or for at least the sealing material are issued from the client computer to the contractor computer, and wherein

the support center computer manages the seal handling

training and receives an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material.

5 11. A seal handling management system comprising: a client computer; a contractor computer; and a support center computer in a linked manner, wherein

 an instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing
10 material and a seal handling tool or for at least the sealing material are issued from the client computer to the contractor computer, wherein

 the support center computer manages the seal handling training and receives an instruction from the client computer to
15 select a sealing material necessary for a seal handling or acquire information of the sealing material, wherein

 the contractor computer notifies at least the client computer of an attendance report of the seal handling training, and wherein

 the client computer receives the attendance report of the seal
20 handling training from at least the contractor computer to issue permission for a seal handling using the sealing material to the contractor computer.

 12. A seal handling management program for causing a client
25 computer, a contractor computer, and a support center computer to implement:

 a function of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center, and a procurement instruction for
30 both a sealing material and a seal handling tool or for at least the sealing material; and

 a function of, by the support center computer, managing the seal handling training and receiving an instruction from the client computer to select a sealing material necessary for a seal handling

or acquire information of the sealing material.

13. A seal handling management program for causing a client computer, a contractor computer, and a support center computer to
5 implement:

a function of issuing from the client computer to the contractor computer an instruction for receiving a seal handling training at a support center, and a procurement instruction for both a sealing material and a seal handling tool or for at least
10 the sealing material;

a function of, by the support center computer, managing the seal handling training and receiving an instruction from the client computer to select a sealing material necessary for a seal handling or acquire information of the sealing material, and, by the
15 contractor computer, notifying at least the client computer of an attendance report of the seal handling training; and

a function of, by the client computer, receiving the attendance report of the seal handling training from at least the contractor computer to issue permission for a seal handling using
20 the sealing material to the contractor computer.

14. A seal handling training method comprising the steps of:

selecting a device required for a training from seal handling
25 devices disposed in one or more training rooms, the seal handling devices including a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device
30 for simulating a heat exchanger; and

acquiring training information from a sensor output of a sensor included in each of the seal handling devices or from an input means.

15. A seal handling training method comprising the steps of:

selecting a device required for a training from seal handling devices disposed in one or more training rooms, the seal handling devices including a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger;

acquiring training information from a sensor output of a sensor included in each of the seal handling devices or from an input means;

receiving the sensor output or the training information to generate simulation information related to a device included in the seal handling devices; and

presenting the simulation information as either or both of character information and graphic information.

16. A seal handling training system comprising:

one or more training rooms;

a seal handling means disposed in the one or more training rooms, the seal handling means including at least one device of a device for simulating piping alignment, a device for simulating tightening, a device for simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger;

an acquiring means that acquires a sensor output of a sensor included in each device of the seal handling means or training information related to the device;

a processing means that receives the sensor output or the training information to generate simulation information related to a device included in the seal handling means; and

an information presenting means wired or wirelessly connected

to the processing means, the information presenting means presenting a process output from the processing means as either or both of character information and graphic information.

5 17. A seal handling training program for causing a computer to implement the functions of:

 selecting a device used for a training from a seal handling means including at least one device of a device for simulating piping alignment, a device for simulating tightening, a device for
10 simulating a sealing state, a device for simulating flange tightening, a device for simulating creep, a device for simulating compression failure, and a device for simulating a heat exchanger;

 acquiring a sensor output of a sensor included in each device of the seal handling means or training information related to the
15 device;

 receiving the sensor output or the training information to generate simulation information related to a device included in the seal handling means; and

 presenting the simulation information as either or both of
20 character information and graphic information.