

DESCRIPTION

Title of Invention

WATER TREATMENT SYSTEM

Technical Field

[0001] The present invention relates to a water treatment system including a plurality of water treatment units and an integrated control panel for controlling the water treatment units.

Background Art

[0002] In a water treatment system including a plurality of water treatment units and an integrated control panel, data communication is performed between the water treatment units and the integrated control panel.

[0003] Patent Literature 1 describes that a sensor and a micro processing unit connected to the sensor are installed in a reverse osmosis (RO) module and data communication is performed by wire (paragraph 0019) between the micro processing unit and a central processing unit. Note that paragraph 0019 of Patent Literature 1 describes that an Arduino (registered trademark) board is used as the micro processing unit.

Citation List

Patent Literature

[0004] PTL1: JP 2019-524440 A

Summary of Invention

Technical Problem

[0005] When each of the plurality of water treatment units and the integrated control panel are connected by wire, wiring work is necessary, the cost of the system is higher, and a work period is longer.

[0006] In the conventional water treatment system, the integrated control panel is individually designed according to a type, the number, and a combination of the water treatment units. Therefore, design cost is higher and a delivery term is longer.

[0007] An object of the present invention is to provide a water treatment system in which wiring work between water treatment units and an integrated control panel is unnecessary.

[0008] In an aspect of the present invention, an object of the present invention is to also collect operation data of existing other water treatment systems separate from a newly installed water treatment system and integrate the newly installed and existing systems to enable operation management.

[0009] An aspect of the present invention has an object to standardize a water treatment unit.

Solution to Problem

[0010] A water treatment system of the present invention comprises: a plurality of water treatment units; an individual controller provided in each water treatment unit; and an integrated control panel that communicates with each individual controller. The individual controllers are capable of communicating with one another and the

individual controllers and the integrated control panel are capable of communicating with each other by short-range wireless communication.

[0011] In an aspect of the present invention, the water treatment system comprises, as the water treatment unit, at least one of a pump, a pretreatment apparatus, an activated carbon filter, an RO apparatus, and a deionizing apparatus.

[0012] In an aspect of the present invention, the water treatment units are standard products.

[0013] In an aspect of the present invention, the short-range wireless communication is ZigBee (registered trademark).

[0014] In an aspect of the present invention, in the individual controllers and the integrated control panel, Arduino (registered trademark) or Raspberry Pi (registered trademark) is used as a microprocessor.

Advantageous Effects of Invention

[0015] Since the water treatment system of the present invention performs wireless communication between the water treatment units and the integrated control panel, wiring work between the water treatment units and the integrated control panel is unnecessary. By standardizing the water treatment units, labor and cost of design of the water treatment system are reduced.

[0016] According to an aspect of the present invention, by adding the same communication function as a communication function of a newly installed system to measurement instruments such as a water level gauge and a flow meter in an existing water treatment system manufactured by another company, it is possible to easily collect

operation data (for example, a water level, a flow rate, pH, and water quality) of the existing system. It is possible to perform operation management in the same manner as operation management of the newly installed system.

[0017] In other words, an integrated control panel of the newly installed system can communicate with unit apparatuses and existing units and perform data transmission and monitoring.

Brief Description of Drawings

[0018]

[Fig. 1] Fig. 1 is a configuration diagram of a water treatment system according to an embodiment.

[Fig. 2] Fig. 2 is a functional block diagram of an individual controller.

Description of Embodiments

[0019] A configuration of a water treatment system according to an embodiment is explained below with reference to Fig. 1. The water treatment system is a pure water apparatus. Feed water such as industrial water, well water, or recovered water is introduced into a feed water tank 1. The feed water in the feed water tank 1 is fed to a pretreatment apparatus (in this embodiment, an MF apparatus) 3 by a feed water pump 2. Pretreatment by MF membrane filtration is performed. Pretreated water is fed to an activated carbon filter 4 and subjected to activated carbon filtration treatment.

[0020] Activated carbon filtered water is fed to an RO (reverse osmosis membrane) apparatus 6 by a high-pressure pump 5. A part of concentrated water from the RO apparatus 6 is returned to the feed water

tank 1 and the remainder is discharged to the outside of the system.

Permeated water from the RO apparatus 6 is fed to a deionizing apparatus (in this embodiment, electrodeionizing apparatus; but may be an ion exchange resin apparatus or the like) 7, subjected to deionization treatment to be treated water (pure water), and introduced into a pure water tank 8. The pure water in the pure water tank 8 is supplied to pure water demand parts (a boiler, a secondary pure water apparatus (a sub-system), and the like).

[0021] Individual controllers 12 to 17 are respectively installed in water treatment units such as the feed water pump 2, the pretreatment apparatus 3, the activated carbon filter 4, the high-pressure pump 5, the RO apparatus 6, and the deionizing apparatus 7. Note that the feed water pump 2, the pretreatment apparatus 3, the activated carbon filter 4, the high-pressure pump 5, the RO apparatus 6, and the deionizing apparatus 7 are sometimes referred to as water treatment units 2 to 7 below.

[0022] Although not illustrated, sensors such as pressure sensors and flow rate sensors are provided in the pumps 2 and 5. Sensors such as pressure sensors and flow rate sensors are provided in the pretreatment apparatus 3, the activated carbon filter 4, and the RO apparatus 6. Sensors such as an electrical conductivity meter and a flow rate sensor are provided in the deionizing apparatus 7.

[0023] Inverter controllers that control pump speed are provided in the individual controllers 12 and 15 of the pumps 2 and 5.

[0024] Backwashing mechanisms are provided in the pretreatment apparatus 3, the activated carbon filter 4, and the RO apparatus 6. The pretreatment apparatus 3, the activated carbon filter 4, and the RO

apparatus 6 are configured to perform backwashing according to control signals received from the individual controllers 13, 14, and 16. The backwashing mechanisms include tanks for storing treated water, pumps for backwashing, pipes for backwashing, and valves.

[0025] The deionizing apparatus 7 includes a power supply device for current control. The power supply device for current control is controlled by a control signal received from the individual controller 17.

[0026] The individual controllers 12 to 17 are enabled to communicate with one another and an integrated control panel 20 and the individual controllers 12 to 17 are enabled to communicate with each other by short-range wireless communication (in this embodiment, a communication standard is ZigBee (registered trademark); but is not limited to this).

[0027] The individual controllers 12 to 17 and the integrated control panel 20 include Arduino (registered trademark) or Raspberry Pi (registered trademark) as microprocessors.

[0028] The individual controllers 12 to 17 include, as shown in Fig. 2, computers including storage units 30 that store programs and operation information data. CPUs (central processing units) of the computers execute the programs, whereby arithmetic control units 31 and signal sorting units 32 are configured. Sensor detection signals of the water treatment units 2 to 7 are input to the arithmetic control units 31 via an A/D converter 33.

[0029] The integrated control panel 20 includes a computer including a storage unit that stores a control program and operation information. A microprocessor of the computer is Arduino (registered trademark) or Raspberry Pi (registered trademark) as explained above. The integrated control panel includes a receiving unit for operation data (including

detection data by the sensors of the water treatment units) signals of the water treatment units 12 to 17, an arithmetic control unit that calculates, based on data received from the receiving unit and stored data, control data to be transmitted to the water treatment units, and a transmitting unit that transmits a control signal according to the control data.

[0030] Signals transmitted from the integrated control panel 20 are received by a receiving unit 34 and input to the signal sorting unit 32. The transmitted signals from the integrated control panel 20 include an ID (unit identification information) for specifying a water treatment unit to which the signal should be given and control information to be given to the water treatment units.

[0031] The signal sorting unit 32 sorts, among the received signals, a signal including an ID for designating the water treatment unit and transmits control information included in the signal to the arithmetic control unit 31. The signal sorting unit 32 transmits a signal including an ID for not designating the water treatment unit to a transmitting unit 35. The transmitting unit 35 transmits the transmitted signal to the other water treatment units by short-range wireless communication.

[0032] The arithmetic control unit 31 transmits sensor detection data received via the A/D converter 33 to the transmitting unit 35. The transmitting unit 35 transmits the data to the integrated control panel 20 and the other water treatment units by short-range wireless communication.

[0033] Further, the arithmetic control unit 31 calculates, according to the control program, control content based on the sensor detection data and the control information received from the integrated control panel 20 via the signal sorting unit 32 and transmits a result of the calculation to

a control signal output unit 36. The control signal is transmitted from the control signal output unit 36 to the water treatment unit and control of the water treatment units 2 to 7 is performed. For example, ON and OFF and rotation speed control for the pumps 2 and 5 are performed and current control for the deionizing apparatus 17 is performed. Switching control for filtering operation and backwashing operation of the pretreatment apparatus 3, the activated carbon filter 4, and the RO apparatus are performed. Note that the control content is not limited to this and various kinds of control other than the above can be performed.

[0034] In this embodiment, since the integrated control panel 20 and the individual controllers 12 to 17 of the water treatment units 2 to 7 perform communication in a short-range wireless communication scheme, the integrated control panel 20 and the water treatment units 2 to 7 do not need to be connected by a cable for data transmission. It is possible to achieve a reduction in installation cost and a reduction in a water treatment system construction work period. A network scheme with which not only the integrated control panel 20 and the individual controllers 12 to 17 but also the individual controllers 12 to 17 communicate with one another by short-range wireless communication is adopted. Communication is performed between the water treatment unit isolated from the integrated control panel 20 and the integrated control panel 20 through the individual controllers of the other water treatment units.

[0035] In this embodiment, the water treatment units 2 to 7 are standard products. That is, the water treatment units 2 to 7 are products, the capacity and the performance of which are preset specifications, and are not products designed to suit an individual site

having specific specification. Therefore, the control program for the water treatment units set in the integrated control panel 20 is also a standard product. Therefore, the water treatment units 2 to 7 and the integrated control panel 20 do not need to be designed or manufactured to suit a site. Labor and cost for the design and the manufacturing are low.

The specific aspects of the present invention are explained in detail above. However, it is evident for those skilled in the art that various changes are possible without departing from the intention and the scope of the present invention.

This application is based on Japanese Patent Application No. 2021-66612 filed on April 9, 2021, the entire contents of which are incorporated herein by reference.

Reference Signs List

- 1 feed water tank
- 3 pretreatment apparatus
- 4 activated carbon filter
- 6 RO apparatus
- 7 deionizing apparatus
- 8 pure water tank
- 20 integrated control panel

CLAIMS

[Claim 1]

A water treatment system comprising:
a plurality of water treatment units;
an individual controller provided in each water treatment unit; and
an integrated control panel that communicates with each individual controller, wherein

the individual controllers are capable of communicating with one another and the individual controllers and the integrated control panel are capable of communicating with each other by short-range wireless communication.

[Claim 2]

The water treatment system according to claim 1, wherein the water treatment system comprises, as the water treatment unit, at least one of a pump, a pretreatment apparatus, an activated carbon filter, an RO apparatus, and a deionizing apparatus.

[Claim 3]

The water treatment system according to claim 1 or 2, wherein the water treatment units are standard products.

[Claim 4]

The water treatment system according to any one of claims 1 to 3, wherein the short-range wireless communication is ZigBee (registered trademark).

[Claim 5]

The water treatment system according to any one of claims 1 to 4, wherein, in the individual controllers and the integrated control panel,

Arduino (registered trademark) or Raspberry Pi (registered trademark) is used as a microprocessor.