【CLAIMS】

【Claim 1】

A system for switching ship fuel oil for an engine between different types of fuel oils, the system comprising:

a supply unit supplying fuel oil;

a circulation unit circulating the fuel oil received from the supply unit; and

a controller controlling the supply unit and the circulation unit,

wherein the supply unit comprises a plurality of tanks respective storing the different types of fuel oils;

the engine receives the fuel oil from the circulation unit;

the fuel oil remaining after use in the engine is recirculated through the circulation unit; and

the controller regulates a blended ratio of the fuel oil to be sent to the engine by controlling flow rates of the different types of fuel oils discharged from the plurality of tanks,

wherein the controller comprises a ratio calculation unit;

the circulation unit further comprises a first temperature sensor measuring a temperature of the fuel oil to be supplied to the engine and a viscosity sensor measuring a viscosity of the fuel oil to be supplied to the engine;

a value of the temperature of the fuel oil measured by the first temperature sensor and a value of the viscosity of the fuel oil measured by the viscosity sensor are transmitted to the ratio calculation unit; and

the ratio calculation unit calculates a blended ratio of the different types of fuel oils in the fuel oil circulating through the circulation unit, and

while the fuel oil being blending, a viscosity of a fuel oil blend supplied to the engine is maintained within a certain range meeting a viscosity level required by the engine while maintaining a rate of temperature change of a fuel oil blend less than or equal to a predetermined value per minute.

【Claim 2】

The system according to claim 1, wherein the supply unit further comprises: a plurality of discharge lines through which the respective different types of fuel oils are

discharged from the plurality of tanks; and a plurality of control valves disposed on the plurality of discharge lines, respectively, and the controller regulates the blended ratio of the fuel oil by adjusting opening rates of the plurality of control valves.

【Claim 3】

The system according to claim 1, wherein the supply unit further comprises a first flow meter measuring a flow rate of the fuel oil to be sent to the circulation unit.

【Claim 4】

The system according to claim 3, wherein the first flow meter indicates a flow rate equal to a fuel oil consumption per hour of the engine.

【Claim 5】

The system according to claim 2, wherein the supply unit further comprises a plurality of check valves disposed on the plurality of discharge lines, respectively.

【Claim 6】

The system according to claim 1, wherein the circulation unit further comprises a circulation pump pressurizing and circulating the fuel oil.

【Claim 7】

The system according to claim 6, wherein the circulation pump maintains a pressure of the fuel oil circulating through the circulation unit at 8 bar to 10 bar.

【Claim 8】

The system according to claim 1, wherein a flow rate of the fuel oil circulating through the circulation unit corresponds to about three times a maximum fuel consumption of the engine.

【Claim 9】

The system according to claim 1, wherein the ratio calculation unit finds a viscosity blending index (VBI) according to Equation: VBI = 14.534×ln(ln(v+0.8))+10.975, where v denotes a viscosity in cSt of each component of the fuel oil circulating through the circulation unit and finds w_A and w_B according to Equations: VBI_blend = (w_A×VBI_A) + (w_B×VBI_B), where w_A denotes a weight proportion of component A in a fuel oil blend and a weight proportion w of each component is determined at a given temperature; and v_blend = exp[exp{(VBI_blend-10.975) ÷ 14.534}] - 0.8, where v_blend denotes a viscosity of the fuel oil blend.

【Claim 10】

The system according to claim 1, wherein the controller further comprises an integrated automation system, the integrated automation system receiving: a value of the blended ratio of the fuel oil calculated by the ratio calculation unit; the value of the temperature of the fuel oil transmitted from the first temperature sensor to the ratio calculation unit; and the value of the viscosity of the fuel oil transmitted from the viscosity sensor to the ratio calculation unit, from the ratio calculation unit.

【Claim 11】

The system according to claim 10, wherein the integrated automation system regulates the temperature and blended ratio of the fuel oil such that the viscosity value of the fuel oil received from the ratio calculation unit meets a viscosity level required by the engine, receives feedback on the regulated temperature of the fuel oil based on the temperature value measured by the first temperature sensor and received from the ratio calculation unit, and

receives feedback on the regulated blended ratio of the fuel oil based on the viscosity value measured by the viscosity sensor and received from the ratio calculation unit.

【Claim 12】

The system according to claim 1, wherein the circulation unit further comprises a heater, and, when a viscosity of the fuel oil circulating through the circulation unit is above a viscosity level required by the engine, the heater heats the fuel oil.

【Claim 13】

The system according to claim 1, wherein the circulation unit further comprises a cooler, and, when a viscosity of the fuel oil circulating through the circulation unit is below a viscosity level required by the engine, the cooler cools the fuel oil.

【Claim 14】

The system according to claim 1, wherein the circulation unit further comprises a fuel oil duct disposed downstream of the engine to temporarily store the fuel oil remaining after use in the engine.

【Claim 15】

A method for switching ship fuel oil for an engine between different types of fuel oils using a system of any one of claims 1 to 14, the method comprising the steps of:

1) supplying only a second type of fuel oil to the engine by fully opening a second control valve supplying the second type of fuel oil and fully closing a first control valve supplying a first type of fuel oil;

2) calculating, by a ratio calculation unit, a blended ratio of the different types of fuel oils in fuel oil to be supplied to the engine;

3) receiving a fuel oil change over signal from a user;

4) gradually opening the first control valve such that the first type of fuel oil is increasingly discharged at a predetermined rate of change in flow rate per hour;

5) gradually closing the second control valve such that the second type of fuel oil is decreasingly discharged at a predetermined rate of change in flow rate per hour, when the first control valve is fully opened;

6) determining that fuel oil change over has been completed, when the second control valve is fully closed and a proportion of the first type of fuel oil calculated by the ratio calculation unit is more than or equal to a predetermined value,

wherein the ratio calculation unit calculates a blended ratio of fuel oil to be supplied to the engine using a temperature and viscosity of the fuel oil as variables, and

while the fuel oil being blending, a viscosity of a fuel oil blend supplied to the engine is maintained within a certain range meeting a viscosity level required by the engine while maintaining a rate of temperature change of a fuel oil blend less than or equal to a predetermined value per minute.

【Claim 16】

The method according to claim15, wherein, when the fuel oil change over signal is received from the user in step 3), a viscosity of fuel oil to be supplied to the engine is automatically set, and, upon determining that fuel oil change over has been completed in step 6), the viscosity of the fuel oil to be supplied to the engine is automatically set.

【Claim 17】

A method for switching fuel oil supplied to a marine engine between a first type of fuel oil and a second type of fuel oil using a system of any one of claims 1 to 14,

wherein the first type of fuel oil has a different viscosity than the second type of fuel oil, and a flow rate of the first type of fuel oil and a flow rate of the second type of fuel oil are controlled such that the time required for mixing the first type of fuel oil with the second type of fuel oil and sending the fuel oil blend to the engine is less than or equal to a predetermined value and a temperature change upon mixing the first type of fuel oil with the second type fuel oil is less than or equal to a predetermined value,

wherein feedback on flow rate control is received by calculating a blended ratio of fuel oil to be supplied to the engine using a viscosity and temperature of the fuel oil as

variables, and

while the fuel oil being blending, a viscosity of a fuel oil blend supplied to the engine is maintained within a certain range meeting a viscosity level required by the engine while maintaining a rate of temperature change of a fuel oil blend less than or equal to a predetermined value per minute.

【Claim 18】

The method according to claim 17, wherein, when only the first type of fuel oil is supplied to the engine, a feed rate of the second type of fuel oil is increased until the feed rate of the second type of fuel oil reaches a maximum value thereof, followed by decreasing a feed rate of the first type of fuel oil such that only the second type of fuel oil is supplied to the engine.