

**Method for switching the fuel supply to an internal combustion engine from a first fuel
to a second fuel**

The invention relates to a method for switching the fuel supply to an internal combustion
5 engine from a first fuel to a second fuel, comprising the steps of a) operating the internal
combustion engine using the first fuel, b) lowering the fraction of the first fuel in the fuel line
supplying the internal combustion engine and increasing the fraction of the second fuel in the
fuel line supplying the internal combustion engine, c) operating the internal combustion
engine using a fuel mixture comprising the first fuel and the second fuel, and d) repeating the
10 steps b) and c) until the internal combustion engine is operated only using the second fuel.

Such a method is known for example from WO 2009/067970 A1, this known method being in
particular based on the problem that a marine engine had to be switched from the operation
with a highly viscous heavy oil to a fuel of lower viscosity, that is diesel oil, it having been
15 intended that the change in viscosity be compensated by adapting the temperature of the fuel
or the fuel mixture.

A fundamental problem of all methods where the operation of an internal combustion engine
is to be switched from the consumption of a first fuel to a second fuel consists in that at first a
20 defined fuel mixture having defined properties must be produced that is changed in favour of
the second fuel until the internal combustion engine can be operated only using the second
fuel.

Adjusting the defined fuel mixture where for example defined fractions of first fuel and
25 second fuel should be present, however turns out to be difficult on account of the different
viscosities of the fuels used and different pressures, in particular if a uniform change of the
fuel composition similar to a ramp function is desired.

Preliminary tests (not published) for this invention have in particular shown that the positions
30 of 3/2 way rotary disc valves provide only insufficient information as to the fractions of first
and second fuel in a fuel mixture.

Therefore the object of the invention is to provide a method and a system using which the fraction of first and second fuel can be precisely adjusted.

- 5 This object is achieved by the method having the features of Claim 1 and the system having the features of Claim 6. The sub claims specify advantageous designs of the invention.

- The basic idea of the invention is to determine the flow rate of the first fuel in the line conducting the first fuel and/or determine the flow rate of the second fuel in the line
10 conducting the second fuel before they are merged in the line that supplies fuel to the internal combustion engine, e.g. a marine engine. The position of a 3/2 way rotary disc valve that interconnects the first fuel line, the second fuel line and the third line supplying the fuel to the internal combustion engine, does not provide any information on the fractions of first and second fuel that are actually present in the third fuel line, on account of the different viscosity
15 and pressure ratios of the types of fuel, so that the effects arising when mixing the types of fuel have to be determined empirically according to the valve position. The same applies for fuel-line arrangements where a valve each is provided in the first and in the second fuel line and the composition of the fuel mixture is a function of the setting of both valves.
- 20 The fuel composition of the fuel mixture can be inferred from the flow rate of at least one fuel - in particular if a measurement of the flow rate also takes place in the third fuel line, it being possible to regulate the fuel composition of the fuel mixture in a defined way by adjusting the corresponding actuator, e.g. the 3/2 way rotary disc valve. Here adjusting the actuator can also take place using the ratios of the flow rate of first or second fuel to the flow rate of the fuel
25 mixture.

- To this end, a control system that is connected to the at least one flow rate measuring device and acting on the at least one actuator for setting the fraction of the first fuel or for setting the fraction of the second fuel in the fuel mixture and that can create a smooth transition from the
30 operation using a first fuel to the operation using a second fuel, for example according to a

predetermined ramp function, using the flow rate of the first fuel and/or the second fuel or the change in the flow rate or rates that occur.

5 The inventive method is particularly suitable for marine engines that must be operated alternately with heavy oil and diesel oil, in particular marine diesel oil (MDO), marine gas oil (MGO) or other low-viscous distillates. However, the method is also suitable for other engines, for example engines operated using diesel and rapeseed oil.

PATENT CLAIMS

1. A method for switching the fuel supply to an internal combustion engine from a first
5 fuel to a second fuel, comprising the steps of
 - a) operating the internal combustion engine using the first fuel,
 - b) lowering the fraction of the first fuel in the fuel line supplying the internal
combustion engine and increasing the fraction of the second fuel in the fuel line
supplying the internal combustion engine by using a 3/2 way rotary disc valve,
 - 10 c) operating the internal combustion engine using a fuel mixture comprising the first
fuel and the second fuel, and
 - d) repeating the steps b) and c) until the internal combustion engine is operated only
using the second fuel,characterized by the steps of
 - 15 determining the flow rate of the first fuel in the line conducting the first fuel and/or
determining the flow rate of the second fuel in the line conducting the second fuel and
adjusting the fraction of the first fuel and the fraction of the second fuel in the fuel
mixture based on the flow rate of the first fuel and/or second fuel.
- 20 2. The method according to Claim 1, characterised by determining the flow rate of the
fuel of fuel mixture conducted in the fuel line supplying the internal combustion engine,
adjusting the fraction of the first fuel and the fraction of the second fuel in the fuel mixture
taking place using the ratio of the flow rate of the first fuel and/or second fuel and the flow
25 rate of the fuel mixture.
3. The method according to one of the preceding claims, characterised in that adjusting
the fraction of the first fuel and the fraction of the second fuel in the fuel mixture takes place
30 using a 3/2 way rotary disc valve.

4. The method according to one of the preceding claims, characterised in that the first fuel is heavy oil and the second fuel is diesel oil.

5 5. The method according to one of the preceding claims, characterised in that the internal combustion engine is a marine engine.

6. A system for switching the fuel supply to an internal combustion engine from a first
10 fuel to a second fuel, having

- a first fuel line conducting a first fuel,

- a second fuel line conducting a second fuel,

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- a third fuel line supplying the internal combustion engine with fuel, a 3/2 way rotary disc valve connecting the first fuel line, the second fuel line and the third fuel line with each other and supplying the internal combustion engine with fuel, and

20 characterised by

at least one flow rate measuring device arranged in the first fuel line and/or in the second fuel line, and

a control system connected to the at least one flow rate measuring device and acting on the
25 3/2 way rotary disc valve for adjusting the fraction of the first fuel or adjusting the fraction of the second fuel in the fuel mixture using the flow rate of the first fuel and/or the second fuel.