

METHOD AND APPARATUS FOR INDIRECT MAGNETIC TREATMENT OF FLUIDS AND GASES

FIELD OF THE INVENTION

5 [001] The present invention pertains generally to the field of magnetic treatment of fluids and/or gases, and more specifically to a method and apparatus for indirect magnetic treatment of fluids and gases, that are based primarily on the mixing between directly magnetized fluids/gases (fluids/gases that are treated using direct magnetic or electromagnetic field of certain geometry and flux density) and normal non-magnetized
10 fluids/gases to obtain new mixed or indirectly-magnetized fluids/gases that have better performance than the directly magnetized fluids/gases and normal non-magnetized fluids/gases.

BACKGROUND OF THE INVENTION

15 [002] Magnetohydrodynamics (MHD) (magnetofluidynamics or hydromagnetics) is the scientific discipline that studies the dynamics of electrically conducting fluids under the effect of magnetic fields. MHD is derived from "magneto" meaning magnetic field, and "hydro" meaning liquid, and "dynamics" meaning movement or motion. The field of MHD was initiated by Hannes Alfvén in 1942, for which he received the Nobel Prize in Physics in
20 1970.

[003] The idea of MHD is that magnetic fields can induce currents in a moving electrically-conductive fluid, which create mechanical forces on the fluid, and also change the magnetic field itself. The set of equations which describe MHD are a combination of the
25 familiar Navier-Stokes equations of fluid dynamics and Maxwell's equations of electromagnetism. Research studies indicate that magnetohydrodynamic effects are responsible for the magnetic treatment of fluids and gases.

[004] All previous applications of magnetic treatment of fluids and gases focused on the direct application of magnetic or electromagnetic fields of various flux densities and
30 variable geometries on the moving fluid or gas, where the entire or the totality of the fluid or gas should pass directly through the magnetic or the electromagnetic field in order to be treated. This direct treatment fact is the hidden obstacle for the limited popularity of the

magnetic treatment since it leads to effective treatment only in the initial phases of installation of magnetic treatment devices, and generally ineffective treatment in the later stages.

SUMMARY OF THE INVENTION

5 [005] It is therefore an object of the present invention to provide a method and apparatus for indirect magnetic treatment of fluids and gases that overcomes the drawbacks of direct magnetic treatment of fluids and gases.

[006] There is provided a method of indirect treatment of fluids or gases, the method comprising: providing a first fluid or gas; applying a direct magnetic or electromagnetic field
10 of certain flux densities and geometries on the first fluid or gas to obtain the directly magnetized fluid/gas; providing a second normal non-magnetized fluid/gas; and mixing the first directly magnetized fluid/gas with the second normal non-magnetized fluid/gas to obtain a third mixed or indirectly-magnetized fluid/gas that is also treated and more effective than the first directly magnetized fluid/gas and the second normal non-magnetized
15 fluid/gas.

[007] This means that according to the present invention, the first fluid/gas is the directly magnetized fluid/gas that undergoes direct magnetic or electromagnetic treatment, while the second fluid/gas is the normal non-magnetized fluid/gas that does not pass through any direct magnetic or electromagnetic field. In the third mixed or indirectly-magnetized
20 fluid/gas, the second normal non-magnetized fluid/gas becomes treated indirectly from the first directly magnetized fluid/gas, and the third mixed or indirectly-magnetized fluid/gas becomes totally treated in an indirect manner. In other words, the first directly magnetized fluid/gas serves as a magnetizer or a magnetic treating agent for magnetizing the second normal non-magnetized fluid/gas

25 [008] In the sense of the present invention, the term "directly magnetized" or "directly treated" or simply "treated" referring to fluids and/or gases particularly means that fluid(s) and/or gas(es) are treated or magnetized, respectively, using direct magnetic or electromagnetic field of certain geometry and flux density, which may be provided, for example, by a device or unit producing said respective field. Furthermore, the term "normal
30 non-magnetized" or "normal", respectively, which refers to fluids and/or gases, particularly

means that the respective fluid(s) and/or gas(es) is not magnetized or does or did not pass through any direct magnetic or electromagnetic field. Additionally, the term "mixed" or "indirectly-magnetized" referring to fluids and/or gases particularly means that fluid(s) and/or gas(es) that becomes magnetically treated in an indirect manner by the directly magnetized fluid/gas that serves as a magnetizer or a magnetic treating agent. Besides, the term "indirect magnetic fluid/gas treatment" particularly means that a normal fluid and/or gas is treated or magnetized, respectively, without being the object of direct magnetic or electromagnetic field (as it is the case with regard to the "directly magnetized" fluid and/or gas), but by being (for example mixed with and thus) magnetized by a "directly magnetized" fluid and/or gas.

[0009] Preferably, the mixing between the first directly magnetized fluid/gas and second normal non-magnetized fluid/gas is carried out in accordance with a predetermined mixing ratio, where the majority of mixture is of the second normal non-magnetized fluid/gas.

[0010] Preferably, the treatment unit that is used for the production of the directly magnetized fluid/gas can be either a permanent magnet setup or an electromagnetic setup using a coil and a controlled current source. The magnetic or electromagnetic field in the treatment unit can be of any geometry (one-dimensional, two-dimensional, or three-dimensional magnetic fields according to the desired flux density values of B_x , B_y , and B_z); the nature of magnetic field can be in the attraction form or in the repulsion form (in case of permanent magnet setup); The required angle between the magnetic field and the direction of fluid/gas flow can be of any angle like 90, 0, 180 degrees or any other required angle.

[0011] Preferably, the process of applying magnetic or electromagnetic fields of certain flux densities and geometries on the directly magnetized fluid/gas within the treatment unit is carried out while the fluid/gas is in circulation.

[0012] Preferably, the production process of the directly magnetized fluid/gas can be achieved using the "inline pre-treatment and post-treatment sensors configuration" that comprises of: first, filling the normal non-magnetized fluid/gas in the treatment vessel from the normal fluid main supply tank; and second, performing a circulation process of a controlled flow through the treatment unit that outputs its flow back to the treatment vessel.

In this configuration, a group of required sensors (that may be application and fluid dependent) are installed before and after the treatment unit that sends its sensory data to the control box in order to trace the changes in the physical and chemical quantities of the directly magnetized fluid/gas with time before and after the treatment unit for analysis purposes.

[0013] Alternatively, the production process of the directly magnetized fluid/gas can be also achieved using the "in-tank sensors configuration" that comprises of: first, filling the normal non-magnetized fluid/gas in the treatment vessel from the normal fluid main supply tank; and second, performing a circulation process of a controlled flow through the treatment unit that outputs its flow back to the treatment vessel. In this configuration, a group of required sensors (that may be application and fluid dependent) are installed in the treatment vessel that the sends its sensory data to the control box in order to trace the changes in the physical and chemical quantities of the directly magnetized fluid/gas with time for the fluid/gas in the treatment tank.

[0014] Alternatively, the production process of the directly magnetized fluid/gas can be also achieved using the "parallel flow configuration" that comprises of: first, filling the normal non-magnetized fluid/gas in the treatment vessel from the normal fluid main supply tank; and second, performing a circulation process of a controlled flow where the treatment vessel simultaneously receives a first controlled flow through the treatment unit and a second controlled flow directly from the treatment vessel.

[0015] Alternatively, the production process of the directly magnetized fluid/gas can be also achieved using the "single-cycle configuration" that comprises of: first, filling the normal non-magnetized fluid/gas in the normal fluid vessel from the normal fluid main supply tank; and second, performing a controlled flow to a second treatment vessel that receives a controlled flow through the treatment unit.

[0016] Preferably, the mixing process can be achieved using the bottom configuration that comprises of: first, depositing the first directly magnetized fluid/gas in the bottom of a mixing vessel; and second depositing the second normal non-magnetized fluid/gas on the

top of the first directly magnetized fluid/gas. This process might be also repeated many times (alternative bottom configuration).

[0017] Alternatively, the mixing process can also be achieved using the top configuration that comprises of: first, depositing the second normal non-magnetized fluid/gas in the bottom of a mixing vessel; and second, depositing the first directly magnetized fluid/gas on the top of the second normal non-magnetized fluid/gas. This process might be also repeated many times (alternative top configuration).

[0018] Alternatively, the mixing process can also be achieved using the parallel flow two-tank configuration that comprises of: providing a first vessel for receiving the first directly magnetized fluid/gas; providing a second vessel for receiving the second normal non-magnetized fluid/gas; and providing a third vessel for receiving the third mixed or indirectly-magnetized fluid/gas that is in connection with the first and second vessels for simultaneously receiving a first controlled flow of the first directly magnetized fluid/gas and a second controlled flow of the second normal non-magnetized fluid/gas.

[0019] Alternatively, the mixing process can also be achieved using the parallel flow one-tank configuration that comprises of: providing an inline magnetic treatment unit for applying the magnetic or electromagnetic field of certain flux densities and geometries on the second normal non-magnetized fluid/gas to yield the first directly magnetized fluid/gas instantaneously; and providing a first vessel for normal non-magnetized fluid/gas in connection with the treatment unit and with a second vessel for the mixed or indirectly-magnetized fluid/gas; where the treatment unit receives from the first vessel a controlled flow of the second normal non-magnetized fluid/gas and applies the magnetic or electromagnetic field on the second fluid/gas; and where the second vessel simultaneously receives a first controlled flow of the first directly magnetized fluid/gas from the treatment unit and a second controlled flow of the second normal non-magnetized liquid from the first vessel.

[0020] Alternatively, the mixing process can also be achieved using the series flow one-tank configuration that comprises of: providing a first vessel for receiving the second normal non-magnetized fluid/gas; providing a second smaller vessel for receiving the first directly magnetized fluid/gas, and providing a third vessel for receiving the mixed or

indirectly-magnetized fluid/gas, where the second small vessel receives a controlled flow of the second normal non-magnetized fluid/gas from the first vessel and outputs a flow of mixed or indirectly-magnetized fluid/gas for the third vessel comprising the first directly magnetized and second normal non-magnetized fluid/gas.

5 [0021] As a further aspect of the invention, there are provided apparatuses for the production of directly magnetized fluid/gas that include inline pre-treatment and post-treatment sensors configuration as shown in figure 1, in-tank sensors configuration as shown in figure 2, parallel flow configuration as shown in figure 3, single-cycle configuration as shown in figure 4.

10 [0022] As a further aspect of the invention, there are provided apparatuses for the mixing processes that include bottom configuration as shown in figure 5, alternative bottom configuration as shown in figure 6, top configuration as shown in figure 7, alternative top configuration as shown in figure 8, parallel flow two-tank configuration as shown in figure 9, parallel flow one-tank configuration as shown in figure 10, series flow one-tank
15 configuration as shown in figure 11.

[0023] As another aspect of the invention, there is provided a method of treating a fluid/gas, the method comprising using a first directly magnetized fluid/gas as a magnetizer or a magnetic treating agent for magnetizing the second normal non-magnetized fluid/gas.

20 [0024] Preferably, using the first directly magnetized fluid/gas as a magnetizer or a magnetic treating agent for magnetizing the second normal non-magnetized fluid/gas comprises mixing the first and second fluid/gas in accordance with a predetermined mixing ratio.

BRIEF DESCRIPTION OF THE DRAWINGS

25 [0025] Further features and advantages of the present invention will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

[0026] Figure 1: shows an exemplary production process of the directly magnetized fluid/gas using Inline pre-treatment and post-treatment sensors configuration.

30 [0027] Figure 2: shows an exemplary production process of the directly magnetized fluid/gas using In-tank sensors configuration

[0028]Figure 3: shows an exemplary production process of the directly magnetized fluid/gas using Parallel flow configuration

[0029]Figure 4: shows an exemplary production process of the directly magnetized fluid/gas using Single-cycle configuration.

5 [0030]Figure 5: shows an exemplary mixing process using Bottom configuration

[0031]Figure 6: shows an exemplary mixing process using Alternative bottom configuration

[0032]Figure 7: shows an exemplary mixing process using Top configuration

[0033]Figure 8: shows an exemplary mixing process using Alternative top configuration

10 [0034]Figure 9: shows an exemplary mixing process using Parallel flow two-tank configuration

[0035]Figure 10: shows an exemplary mixing process using Parallel flow one-tank configuration

[0036]Figure 11: shows an exemplary mixing process using Series flow one-tank configuration

15 [0037]Figure 12: shows an exemplary Coil setup for generating variable electromagnetic field.

[0038]Figure 13: shows an exemplary Permanent magnet setup for generating variable electromagnetic field.

[0039]Figure 14: shows an exemplary Hydraulic Circuit for permanent magnet setup.

20 [0040]Figure 15: shows an exemplary Magnets Rotation of Permanent magnet setup using stepper motor.

[0041]Figure 16: shows an exemplary Magnetic field polarity manual flipping of permanent magnet setup.

25 [0042]Figure 17: shows exemplary Possible Pipe configurations under the effect of magnetic field.

[0043]Figure 18: shows an exemplary three-dimensional Flux density of permanent magnet setup using attraction mode used in the application case.

[0044]Figure 19: shows an exemplary three-dimensional Flux density of permanent magnet setup using repulsion mode used in the application case.

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[0045] DETAILED DESCRIPTION OF THE INVENTION

[0046] In accordance with a first aspect of the present invention, there is, as an example, provided a method for indirect magnetic fluid/gas treatment where the normal fluid/gas is magnetically treated without being the object of direct magnetic or electromagnetic field.

[0047] The method of indirect magnetic fluid/gas treatment may comprise one, more or all the following steps:

1. Produce the first directly magnetized fluid/gas by:-

a. applying direct magnetic or electromagnetic field on the working fluid/gas according to one, more or all of the following requirements:

i. The required geometry of the magnetic field. We can apply one-dimensional, two-dimensional, three-dimensional magnetic fields.

ii. The required values of the flux densities B_x , B_y , and B_z .

iii. The nature of magnetic field whether in the attraction form or in the repulsion form. This is applied only in case of permanent magnets.

iv. The required angle between the magnetic field and the fluid/gas flow where the angle might be 90, 0, 180 degrees or any other required angle.

v. The required temperature, pressure, and volume of the working fluid/gas.

b. Circulating the working fluid/gas under the effect of magnetic or electromagnetic field according to the selected treatment configuration (as shown in figures 1 to 4) for the required time of circulation. The circulation process might at least be one time of passage of the working fluid/gas across the magnetic or electromagnetic field and might go up to several days.

2. Mix the first directly magnetized fluid/gas with the second normal non-magnetized fluid/gas at the required mixing ratio between the volume of the first directly magnetized fluid/gas (V_t) and the volume of second normal non-magnetized fluid/gas (V_n) according to the selected mixing configuration (as shown in figures 5 to 11). The mixing process might be in one of the following forms:

a. Addition of one type of fluid at a time in a mixing vessel. This process might take one of the following configurations.

- i. Bottom configuration. Add the first directly magnetized fluid/gas at the bottom of the mixing vessel then add the second normal non-magnetized fluid/gas at the top as shown in figure 5.
- 5 ii. Alternative bottom configuration. Add the first directly magnetized fluid/gas at the bottom of the mixing vessel then add the second normal non-magnetized fluid/gas at the top. Then repeat this process many times as shown in figure 6.
- 10 iii. Top configuration. Add the second normal non-magnetized fluid/gas at the bottom of the mixing vessel then add the first directly magnetized fluid/gas at the top as shown in figure 7.
- iv. Alternative top configuration. Add the second normal non-magnetized fluid/gas at the bottom of the mixing vessel then add the directly magnetized fluid/gas at the top. . Then repeat this process many times as shown in figure 8.
- 15 b. Parallel flow two-tank configuration. In this scenario, we have one tank for directly magnetized fluid/gas, a second tank for the normal non-magnetized fluid/gas and a third tank for the mixed or indirectly-magnetized fluid/gas. Two proportional valves are placed at the first and second tank outputs that control the simultaneous mixing ratio between the directly magnetized fluid/gas and the
- 20 normal non-magnetized fluid/gas as shown in figure 9.
- c. Parallel flow one-tank configuration. In this scenario, we have one tank for the normal non-magnetized fluid/gas and a second tank for the mixed or indirectly-magnetized fluid/gas. Two output pipes are coming out from the first tank in a parallel manner. The first pipe goes through the magnetic treatment unit and the
- 25 output of the treatment unit (directly magnetized fluid/gas) is mixed in the second mixing tank. Two proportional valves are placed at the first tank outputs that control the simultaneous mixing ratio between the directly magnetized fluid/gas and the normal non-magnetized fluid/gas. Actually this is the case where we don't have a storage tank for the directly magnetized or treated fluid/gas and the
- 30 fluid/gas is treated instantaneously through the treatment unit before being mixed

in the second tank with the normal non-magnetized fluid/gas. It is to be noted that the flow within the magnetic treatment unit might have different internal flow rate during the treatment from the output flow rate coming out of it as shown in figure 10.

5 d. Series flow one-tank configuration. Here a simultaneous series mixing between the directly magnetized fluid/gas and the normal non-magnetized fluid/gas is performed. In this scenario, we have one tank for directly magnetized fluid/gas, second tank for the normal non-magnetized fluid/gas and a third tank for the mixed or indirectly-magnetized fluid/gas. The normal non-magnetized fluid/gas
10 flow from its tank that is controlled by proportional valve and passes through the treated tank where the output flow of treated tank can be used immediately in the application or stored in the third mixed tank. In this case, the volume of the treated tank and the proportional value opening ratio are the controlling parameters as shown in figure 11.

15 3. Use the mixed or indirectly-magnetized fluid/gas in the proper application. In this case, we have two scenarios. In the first scenario, the mixed or indirectly-magnetized fluid/gas is stored in the mixing tank for later use, while in the second scenario; the mixed or indirectly-magnetized fluid/gas is used immediately in the application without being stored in the mixing tank.

20 [0048] It is to be noted that the previously mentioned treatment process have one, more or all of the following controlling parameters that are fluid/gas dependent and application dependent:

1. direct magnetic or electromagnetic field treatment parameters of the directly
25 magnetized fluid/gas:

- a. The dimension and the geometry of the magnetic field (one-dimensional, two-dimensional, three-dimensional).
- b. The desired values of flux densities (B_x , B_y , B_z) depending on the given dimension.
- 30 c. The nature of magnetic field whether in the attraction form or in the repulsion form (in case of permanent magnets setup).

- d. The required angle between the magnetic field and the fluid/gas flow where the angle might be 90 degrees (perpendicular direction), 0 degree (in the same direction), 180 degrees (in the opposite direction) or any other required angle.
- e. The required volume of the directly magnetized fluid/gas.
- 5 f. The required temperature and pressure of the directly magnetized fluid/gas.
- g. The flow rate of the fluid/gas under the effect of the field.
- h. The required circulation time or application time of the magnetic field upon the fluid/gas.
- i. The geometry of the pipes under magnetic treatment and their inner cross
- 10 sections.

2. mixing process parameters:

- a. The volume of normal non-magnetized fluid/gas.
- b. The volume of directly magnetized fluid/gas.
- c. The required temperature and pressure of the normal non-magnetized fluid/gas
- 15 and the directly magnetized fluid/gas.
- d. The mixing ratio between the two fluids controlled by the proportional valves openings whenever used.
- e. The mixing flow rates for the normal non-magnetized fluid/gas and the directly magnetized fluid/gas

[0049] The principal characteristics of the present invention may comprise one, more or all of:

- 1. Use of directly magnetized or treated fluid/gas as a magnetizer or magnetic treating agent for the normal non-magnetized fluid/gas.
- 25 2. Use of the magnetic field stored in the directly magnetized fluid/gas as a treatment methodology for the normal non-magnetized fluid/gas.
- 3. Use of one-dimensional, two-dimensional, or three-dimensional magnetic geometries of certain flux densities in the preparation of the directly magnetized fluid/gas. In case of permanent magnets setup, up to three-dimensional flux
- 30 densities can be generated, depending on the distance between the magnetic setup, the geometry of the magnetic setup, and the attraction or repulsion forces between the magnetic setup.

4. Use of any magnetic or electromagnetic setup in the preparation of the directly magnetized fluid/gas. This includes the type of magnets used (NdFeb, or any other magnetic material), the shape of the magnets (rectangular, cylindrical, or any other shape), the number of magnets used, the three-dimensional configuration of the setup, and other related parameters regarding the setup.
5. Use of flux densities (B_x , B_y , B_z) ranging from few gaussses to the range of Teslas in the preparation of the directly magnetized fluid/gas.
6. Use of magnetic field whether in the attraction form or in the repulsion form in case of permanent magnets in the preparation of the directly magnetized fluid/gas.
7. A Current control system in case of electromagnetic field setup might be a DC current source or a DC voltage source in series with a variable resistor. In case of using an AC source, then a converter can be used to convert it to DC and then apply one of the two previous scenarios.
8. The temperature, pressure, and volume (level) of the directly magnetized fluid/gas are tuned and controlled during the generation of directly magnetized fluid/gas and the mixing process.
9. The temperature, pressure, and volume (level) of the normal non-magnetized fluid/gas and the mixed or indirectly-magnetized fluid/gas are tuned and controlled during the mixing process and in the storage phases.
10. The heating or cooling element anywhere used in the figures means a heating and/or cooling system that controls the temperature of the fluid/gas exactly as required.
11. During the preparation of the directly magnetized fluid/gas, a flow control system for the working fluid/gas can be used to control the flow rate of the fluid/gas that is moving under the effect of the magnetic field.
12. All of the controlling parameters of the present invention might be controlled according to inline sensors data that can be used in both phases of the treatment (generation of directly magnetized fluid/gas and the mixing process). These sensors are fluid/gas dependent and application dependent. For example in case of fuel treatment, we have used inline viscosity and density sensors to

observe the changes in the physical parameters of the fluid/gas. If the working fluid/gas is water, we might use inline PH and TDS sensors or any other sensors.

13. Use of most commonly used modes of operation regarding the angle between the magnetic field and the fluid/gas flow where the angle might be 90, 0, 180 degrees or other angles depending on the source of magnetic field and the shape of the pipe in which the fluid/gas is flowing.

14. The magnetic field in the preparation of the directly magnetized fluid/gas might be generated using permanent magnet setup (for example, but not limited to, the figures 13 to 16) or electromagnetic field where a dc current is passing in a coil (for example, but not limited to, figure 12).

15. In case of variable distance permanent magnets setup, an actuation mechanism that controls the distance between the two magnets might be hydraulic, pneumatic, electric actuator or any other possible mechanism.

16. The shape of the pipe in which the fluid/gas is flowing under the effect of the magnetic field which might be straight, vertical-horizontal, helical three-dimensional (spring like) shapes or any other shape as shown in figure 17.

17. The fluid/gas flow under the effect of the magnetic field during the preparation of the directly magnetized fluid/gas might be under the effect of gravitational forces in case of vertical flow or might be horizontal flow.

18. Use of circular, square, or rectangular cross sections of the inner core of the pipe under the effect of the magnetic field as shown in figure 17.

19. The diameter of the pipe in which the fluid/gas is flowing under the effect of the magnetic field might be in the micro level or the macro level or might take any value from Pico size to centimeters size.

20. The directly magnetized fluid/gas might be generated using one circulation time (one passage in the magnetic field) or might be circulated continuously for certain period of time.

21. The mixing ratio between the directly magnetized fluid/gas and the normal non-magnetized fluid/gas generally depends on the working fluid/gas, the operating temperature and pressure of the working fluid/gas, the flux density in three dimensional spaces, the angle between the fluid/gas flow and the applied flux, the circulation time, and the application.

22. The directly magnetized fluid/gas and the mixed or indirectly-magnetized fluid/gas might be kept at certain pressure and temperature for certain duration during their storage for later use. This process controls the magnetic memory of both fluids/gases.

23. The normal non-magnetized fluid/gas and the directly magnetized fluid/gas have generally the same chemical structure, but in some applications, they might have different chemical structure.

24. Possible applications for the invention might include, but not limited to, all conventional applications of the direct magnetic treatment of fluid/gas such as water treatment for agricultural purposes, water treatment for scaling, water treatment for salinity reduction, water treatment for construction, fuel treatment, diesel treatment, gasoline treatment, kerosene treatment, fuel oil treatment, jet fuel treatment and all other existing magnetic treatment methods.

[0050] Application case

[0051] The method and apparatus in accordance with the present invention were applied in the treatment of diesel fuel. In this example, a pair of rectangular NdFeb magnet setup of the size 15*10*6 cm for each magnet was used in the magnetic treatment setup shown in figures 13 to 16. Figure 18 shows the magnetic flux densities (B_x , B_y , B_z) at the central point across width and length of the magnet as a function of the inner distance between the magnets for the attraction case. Figure 19 shows the magnetic flux densities (B_x , B_y , B_z) at the central point across width and length of the magnet as a function of the inner distance between the magnets for the repulsion case. For treatment purposes, the magnets were operated in the attraction case and separated by 2 cm distance. First, the diesel was treated for 36 hours and, then, this directly magnetized diesel was mixed with a normal diesel in accordance with various mixing ratios. The results of heat content of the mixed or indirectly-magnetized diesel and the corresponding viscosity and density are given in Table 1. The mixing ratio is by volume and the total sample volume is one liter.

[0052] Although the above description of the application case contains many specificities, these should not be construed as limitations on the scope of the invention but is merely

representative of the presently preferred embodiments of this invention. The embodiment(s) of the invention described above is (are) intended to be exemplary only. The scope of the invention is therefore intended to be limited solely by the scope of the appended claims.

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Sample Name	Mixing Procedure	Heat Content (cal/g)	Dynamic Viscosity	Static Viscosity	Density
normal non-magnetized diesel	Normal non-magnetized alone	10504	4.4326	5.2925	0.8375
magnetic treated diesel	Treated alone	10487	3.3581	4.0311	0.8331
60% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10752	5.2446	6.219	0.8433
50% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10777	5.2044	6.1702	0.8435
40% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10802	5.1473	6.1042	0.8432
30% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10827	5.0594	6.002	0.843
2% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10852	4.7976	5.7043	0.8411
1% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10841	4.8053	5.7178	0.8404
0.2% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	11123	4.7722	5.675	0.8409
0.1% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10810	4.7976	5.7038	0.8411
0.02% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10962	4.776	5.679	0.841
0.01% magnetic treated diesel	treated diesel at the top of normal non-magnetized diesel	10817	4.4498	5.3113	0.8378

Table 1

CLAIMS

1. A method of indirect magnetic treatment of diesel fuel, the method comprising:
 - providing a first vessel;
 - providing a second vessel;
 - providing a third vessel;
 - providing a non-magnetized diesel fuel, and applying a direct magnetic or electromagnetic field of certain flux densities and geometries with a treatment unit on the non-magnetized diesel fuel to obtain directly magnetized diesel fuel;
 - storing the directly magnetized diesel fuel in the first vessel;
 - providing a non-magnetized diesel fuel in the second vessel;
 - mixing the directly magnetized diesel fuel and the non-magnetized diesel fuel; and
 - storing the mixed diesel fuel in the third vessel.
2. The method of treating a diesel fuel as claimed claim 1, wherein the treatment unit for the production of the directly magnetized diesel fuel includes a permanent magnet setup or an electromagnetic setup using coil(s) and controlled current/voltage source(s).
3. The method of treating a diesel fuel as claimed in any of the preceding claims, wherein magnetic or electromagnetic fields of certain flux

densities and geometries on the is applied to the diesel fuel directly within the treatment unit is carried out while the diesel fuel is in circulation.

4. The method of treating a diesel fuel as claimed in any of the preceding claims, wherein the production process of the directly magnetized diesel fuel comprises:

filling the non-magnetized diesel fuel in the first vessel; and

circulating the diesel fuel from the first vessel through the treatment unit that outputs the diesel fuel back to the first vessel.

5. The method of treating a diesel fuel as claimed in any of claims 1-4, wherein the mixing comprises:

depositing the directly magnetized diesel fuel in the bottom of third vessel; and

depositing the non-magnetized diesel fuel on the top of the directly magnetized diesel fuel.

6. The method of treating a diesel fuel as claimed in any of claims 1-4, wherein the mixing comprises:

depositing the non-magnetized diesel fuel in the bottom of third vessel; and

depositing the directly magnetized diesel fuel on the top of the non-magnetized diesel fuel.

7. A method of indirect magnetic treatment of a diesel fuel as claimed in any of the preceding claims, the method comprising using a directly magnetized diesel fuel as a magnetizer or a magnetic treating agent for magnetizing the normal non-magnetized diesel fuel.

8. The method of treating a diesel fuel as claimed in any of the preceding claims, wherein the directly magnetized diesel fuel is used immediately in the mixing process, or stored for short or long term storage for later usage in the mixing process.

9. The method of treating a diesel fuel as claimed in any of the preceding claims, wherein the mixed diesel fuel is used immediately in the intended application, or stored for short or long term durations for later usage in the intended application.