(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 January 2019 (17.01.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/013727 A2

(51) International Patent Classification:
Not classified

(21) International Application Number:
PCT/TR2017/050707

(22) International Filing Date:
27 December 2017 (27.12.2017)

(25) Filing Language: Turkish

(26) Publication Language: English

(30) Priority Data:
2016/20006 29 December 2016 (29.12.2016) TR

(71) Applicant: **AYGAZ ANONIM SIRKETI** [TR/TR]; Buyukdere Caddesi, No:145/1, Aygaz Han, Zincirlikuyu, 34394 Istanbul (TR).

(72) Inventors: **ISBILEN, Emrah**; Buyukdere Cad. No:145/1, Aygaz Han, Zincirlikuyu, 34394 Istanbul (TR). **AZAK, Nabi Onur**; Buyukdere Cad. No:145/1, Aygaz Han, Zincirlikuyu, 34394 Istanbul (TR). **BIRSEN, Emrah**; Erenler Mah. Devebagirtan Sok., Toki Konutlari, C1 Blok, Kat:9 Daire:42, 41060 Izmit/Kocaeli (TR).

(74) Agent: **CAYLI, Hulya**; Paragon Consultancy Incorporated, Koza Sokak, 63/2 GOP, 06540 Ankara (TR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) Title: LPG FILTRATION SYSTEM AND METHOD

(57) Abstract: The filtration system developed by the present invention, for bulk LPG wherein LPG is transferred by means of a tanker truck to an end-user storage tank, is suitable to filter LPG in the end-user LPG storage tank as LPG is transferred to the tank of the tanker truck before it is introduced into the tank of the tanker truck, and the system comprises at least one column which is made of a material suitable for use with LPG; through which the LPG in a transfer line, which provides the transfer of LPG between the end-user storage tank and the tank of the tanker truck, is passed; in which an adsorbent substance, retaining any heavy hydrocarbons in LPG during this transfer so as to reduce the amount of heavy hydrocarbons in LPG, is provided; which is provided with at least one inlet receiving LPG supplied from a transfer line's end user storage tank connection and at least one outlet through which LPG contained in the column is supplied back to the transfer line with a reduced heavy hydrocarbon content, in order to position the filtration system in the transfer line such that the LPG is filtered after the transfer line's storage tank connection and before the connection of the tanker truck's tank with the transfer line.

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LPG FILTRATION SYSTEM AND METHOD

Technical Field

The present invention relates to a system and a method for the filtration of LPG (liquefied petroleum gas) in a storage tank as LPG is transferred out to a tank of a tanker truck.

Prior Art

Liquefied petroleum gas (LPG) is a mixture of hydrocarbon gases made up of propane and butane and is used in different fields. One of these fields is the use of LPG in industrial facilities and in single detached houses, the so-called bulk LPG, wherein LPG is transported to an end user by means of a tanker truck and transferred to a storage tank of the user.

The LPG in the user's storage tank can be in a gas or liquid phase. When LPG is consumed in gas phase, any heavy hydrocarbon structures which cannot get into the gas phase during the gasification of LPG remain in liquid form and settle down in the storage tank. On the other hand, when LPG is consumed in liquid phase from the storage tank, liquid LPG is taken out from the tank at a certain height from the bottom of the tank (preferably at a distance from the bottom of about 10% of the total height of the tank), such that the heavy hydrocarbon structures settled down in the tank are prevented from reaching the system where LPG is used. However, for various reasons (e.g. conducting hydrostatic tests in the storage tank or discarding the tank), it may be required to discharge all LPG present in the storage tank and thus LPG is transferred to the tank of a tanker truck. As stated above, the heavy hydrocarbon content remaining at the bottom of user storage tanks is quite high. LPG, when transferred to the tank of a tanker truck, fails to conform the required standards in evaporation analysis and results in two problems: risk of illegitimate LPG transport and inconvenience of LPG from the tank of tanker truck for reuse.

Since LPG is not conforming the standards and is not convenient for reuse, the LPG present in the tank of a tanker truck cannot be transferred to LPG storage tanks present in

LPG facilities. In order to solve the problem above according to the prior art, LPG having a heavy hydrocarbon content in a tank of a tanker truck is distributed or shared to more than one tanker trucks and is fractionated for use such that the quality of LPG in the tanks is not deteriorated. This raises the costs and leads to operational difficulty.

Brief Description of Invention

The filtration system developed by the present invention, for bulk LPG wherein LPG is transferred by means of a tanker truck to an end-user storage tank, is suitable to filter LPG in the end-user LPG storage tank as LPG is transferred to the tank of the tanker truck before it is introduced into the tank of the tanker truck, and the system comprises at least one column which is made of a material suitable for use with LPG; through which the LPG in a transfer line, which provides the transfer of LPG between the end-user storage tank and the tank of the tanker truck, is passed; in which an adsorbent substance, retaining any heavy hydrocarbons in LPG during this transfer so as to reduce the amount of heavy hydrocarbons in LPG, is provided; which is provided with at least one inlet receiving LPG supplied from a transfer line's end user storage tank connection and at least one outlet through which LPG contained in the column is supplied back to the transfer line with a reduced heavy hydrocarbon content, in order to position the filtration system in the transfer line such that the LPG is filtered after the transfer line's storage tank connection and before the connection of the tanker truck's tank with the transfer line.

The LPG filtration method developed according to the present invention, in turn, comprises the steps of connecting a filtration system to a transfer line performing the transfer of LPG from an end-user storage tank to the tank of a tanker truck so that it is positioned between the storage tank transfer line connection and the connection of the tanker truck with the transfer line; starting a sucking operation of LPG from the storage tank; during this sucking operation, transferring the LPG in the storage tank through the storage tank connection to the transfer line and from here, to the column provided in the filtration system through the inlet of the column; passing the LPG reaching the column through the adsorbent substance provided in the column retaining heavy hydrocarbons so that the adsorbent substance retains the heavy hydrocarbon structures in LPG in its own pores and the heavy hydrocarbons in LPG are separated from LPG; and supplying the LPG with reduced heavy hydrocarbon content through the outlet of the column back to the

transfer line and from here, to the tanker truck's tank by means of the tanker truck's tank connection.

By virtue of the LPG filtration system and method developed according to the present invention, LPG is filtered while it is transferred from the end-user storage tank to the tank of a tanker truck such that the heavy hydrocarbon content of LPG is retained by the adsorbent, and LPG with a reduced heavy hydrocarbon content according to standards is supplied back to the tank of the tanker truck. Thus, both the transport of problematic LPG not complying with the standards is prevented, and LPG taken from an end user is directly transported to a storage tank at an LPG facility such that time and financial losses are avoided.

Object of Invention

The object of the present invention is to develop an LPG filtration system for use with LPG (i.e. use with bulk LPG) transported from a tanker truck's tank to an end user, as well as a filtration method suitable for use with this system.

Another object of the present invention is to develop an LPG filtration system providing the filtration of heavy hydrocarbon structures contained in LPG received from an end-user storage tank, as well as a filtration method suitable for use with this system.

A further object of the present invention is to develop an LPG filtration system for transporting LPG taken from an end-user storage tank to a storage tank at an LPG facility in compliance with relevant standards, as well as a filtration method suitable for use with this system.

Another object of the present invention is to develop an LPG filtration system providing an LPG transport in compliance with relevant standards, as well as a filtration method suitable for use with this system.

A further object of the present invention is to develop an LPG filtration system for transporting LPG taken from an end-user storage tank to a storage tank at a gas station in a simpler manner with lower costs, as well as a filtration method suitable for use with this system.

Description of Invention

As required by standards, the amount of heavy hydrocarbons in LPG should be at/below a certain level, and the amount of evaporation residue of LPG should not exceed a predetermined level (50 ppm in line with standards). However, in the case of bulk LPG use wherein LPG is transported by means of a tanker truck to an end-user storage tank and is used in gas phase, the heavy hydrocarbon structures which cannot get into the gas phase and/or in case LPG is used in liquid phase and is sucked out of the storage tank at a predetermined height from the bottom of the storage tank, heavy hydrocarbon structures accumulate at the bottom of the storage tank. As a result of this accumulation, when the entire content of LPG in the storage tank is transferred to a tanker truck, the amount of evaporation residue of the transferred LPG exceeds a predetermined value (e.g. 300 ppm and above) and fail to fulfill the relevant standards. This results in a transport of problematic LPG not complying with the standards and the transported LPG cannot be directly taken to a storage tank at a gas station, for example. In order to solve this problem, LPG not complying with the standards is transferred to different tanker trucks and fractionated, and LPG present in each tanker truck is made to comply with the standards, but this gives rise to both operational difficulty and loss of time and cost. For this reason, a filtration system for solving these problems, as well as a filtration method suitable for use with this system have been developed according to the present invention.

The filtration system developed by the present invention, for bulk LPG wherein LPG is transferred by means of a tanker truck to an end-user storage tank, suitable to filter LPG in the end-user LPG storage tank as LPG is transferred to the tank of the tanker truck before it is introduced into the tank of the tanker truck, is suitable to be positioned in a transfer line, which provides the transfer of LPG between the end-user storage tank and the tank of the tanker truck, such that the LPG is filtered after the transfer line's storage tank connection and before the connection of the tanker truck's tank with the transfer line (between these two connections).The filtration system developed according to the present invention comprises at least one (preferably more than one) column which is made of a material suitable for use with LPG; through which the LPG in the transfer line is passed; in which an adsorbent substance, retaining any heavy hydrocarbons in LPG during this transfer so as to reduce the amount of heavy hydrocarbons in LPG, is provided; which is provided with at least one inlet receiving LPG supplied from a transfer line's end user storage tank connection and at least one outlet through which LPG contained in the

column is supplied back to the transfer line with a reduced heavy hydrocarbon content. By virtue of the filtration system developed according to the present invention, LPG received from an end-user storage tank is filtered from its heavy hydrocarbon content immediately before it is transferred to a tanker truck. Thus, both LPG supplied to the tanker truck is made complying with the standards such that the problematic transport of improper LPG is avoided, and LPG can be transferred to LPG storage tanks in an LPG facility directly without requiring any extra operations such that time and cost losses are reduced.

In a preferred embodiment according to the present invention, the column is a seamless drawn steel tube (e.g. sch 40). Thus, LPG is safely filtered and a filtration system with a long service life is obtained. In another embodiment, the column can be positioned in a horizontal or vertical manner.

In another preferred embodiment according to the present invention, the adsorbent substance can be activated carbon, zeolite and/or clay.

In another representative embodiment, the filtration system developed according to the present invention can either be a standalone, external, portable unit, or a unit connected to a tanker truck.

In the filtration method developed according to the present invention, the filtration system developed using the transfer line performing the transfer of LPG from an end-user storage tank to a tanker truck is first positioned so as to be between the connection of the storage tank and the connection of the tanker truck (i.e. the inlet of the filtration system is connected to the connection of the storage tank and the outlet is connected to the connection of the tanker truck). Then, the sucking operation of LPG from the storage tank is started and during this sucking operation, LPG in the storage tank is transferred through the connection of the storage tank to the transfer line and from here to the column provided in the filtration system through an inlet of the column. LPG reaching the column is passed through (contacted with) an adsorbent substance provided in the column to retain heavy hydrocarbons so that the adsorbent substance retains the heavy hydrocarbon structures in LPG in its own pores. Thus, the heavy hydrocarbons in LPG are separated from LPG, and the LPG with a reduced heavy hydrocarbon content now is supplied through the outlet of the column back to the transfer line and from here back to the tanker truck's tank by means of the tanker truck's tank connection. In result, the heavy

hydrocarbon content of LPG leaving the filtration system is substantially reduced and the amount of evaporation residue of LPG is made to comply with the standards.

By virtue of the LPG filtration system and method developed according to the present invention, LPG is filtered while it is transferred from the end-user storage tank to the tank of a tanker truck such that the heavy hydrocarbon content of LPG is retained by the adsorbent, and LPG with a reduced heavy hydrocarbon content according to standards is supplied back to the tank of the tanker truck. Thus, both the transport of problematic LPG not complying with the standards is prevented, and LPG taken from an end user is directly transported to a storage tank at an LPG facility such that time and financial losses are avoided.

CLAIMS

1. A filtration system, for bulk LPG wherein LPG is transferred by means of a tanker truck to an end-user storage tank, suitable to filter LPG in the end-user LPG storage tank as LPG is transferred to the tank of the tanker truck before it is introduced into the tank of the tanker truck, characterized in that
the filtration system comprises at least one column
   - which is made of a material suitable for use with LPG,
   - through which the LPG in a transfer line, which provides the transfer of LPG between the end-user storage tank and the tank of the tanker truck, is passed,
   - in which an adsorbent substance, retaining any heavy hydrocarbons in LPG during this transfer so as to reduce the amount of heavy hydrocarbons in LPG, is provided,
   - which is provided with at least one inlet receiving LPG supplied from a transfer line's end user storage tank connection and at least one outlet through which LPG contained in the column is supplied back to the transfer line with a reduced heavy hydrocarbon content, in order to position the filtration system in the transfer line such that the LPG is filtered after the transfer line's storage tank connection and before the connection of the tanker truck's tank with the transfer line.

2. The filtration system according to Claim 1, characterized in that said column is a seamless drawn steel tube.

3. The filtration system according to Claim 1, characterized in that said column is positioned horizontally.

4. The filtration system according to Claim 1, characterized in that said column is positioned vertically.

5. The filtration system according to Claim 1, characterized in that said adsorbent substance is activated carbon.

6. The filtration system according to Claim 1, characterized in that said adsorbent substance is zeolite.

7. The filtration system according to Claim 1, characterized in that said adsorbent substance is clay.

8. The filtration system according to Claim 1, characterized in that the system is a standalone, external, portable unit.

9. The filtration system according to Claim 1, characterized in that the system is a unit coupled to a tanker truck.

10. An LPG filtration method suitable for use in a filtration system according to any one of the preceding claims, the method comprising the steps of

- connecting the filtration system to the transfer line performing the transfer of LPG from an end-user storage tank to the tank of a tanker truck so that it is positioned between the storage tank transfer line connection and the connection of the tanker truck with the transfer line;
- starting a sucking operation of LPG from the storage tank;
- during this sucking operation, transferring the LPG in the storage tank through the storage tank connection to the transfer line and from here, to the column provided in the filtration system through the inlet of the column;
- passing the LPG reaching the column through the adsorbent substance provided in the column retaining heavy hydrocarbons so that the adsorbent substance retains the heavy hydrocarbon structures in LPG in its own pores and the heavy hydrocarbons in LPG are separated from LPG; and
- supplying the LPG with reduced heavy hydrocarbon content through the outlet of the column back to the transfer line and from here, to the tank of the tanker truck by means of the tanker truck connection.