

SOLUBLE AND MELTABLE PACKING CONTAINER, BITUMEN PACKING AND MELTING SYSTEMS

Field of the Invention

[0001] The present invention relates to technologies for packing and melting bitumen, and particularly to a soluble and meltable packing container, a bitumen packing system, and a packing container melting system.

Background of the Invention

[0002] Traditionally, hot bitumen is filled into steel drums and then left to cool, so that the majority of bitumen transported in cold form is by way of this method. This requires two-step operation as hot bitumen contracts on cooling and steel drums need be topped up. The steel drums shall be of a fixed top type for security of transport. The tops of the steel drums have to be cut off by end users to allow decant the bitumen from the steel drums, which results in damaged steel drums with residual bitumen inside. The residual bitumen is disposed of with the damaged steel drums, causing a loss of 3 to 5% of the bitumen. Furthermore, the steel drums are expensive.

[0003] Therefore, there is an imperative need to fully or substantially eliminate the constraints existing in the current bitumen packing with steel drums.

Summary of the Invention

[0004] The present invention provides a soluble and meltable packing (SMP) container for packing and transportation of bitumen. The SMP container is soluble, meaning that all materials from the SMP container when melted are soluble in the bitumen, resulting in complete dissolution of the melted SMP container into the melted bitumen. The SMP container is meltable, meaning that the SMP container can be thermally melted together with the bitumen.

[0005] The present invention provides a bitumen packing system in accordance with certain embodiments of the present invention. In principle, the bitumen packing system packs the bitumen that has been cooled to a predetermined temperature prior to injection.

[0006] The present invention provides a packing container melting system in accordance with certain embodiments of the present invention. Briefly, the packing container melting system comprises a melting tank that is provided with a heating means to melt an SMP container filled with packed bitumen, and a mixing means for mixing the melted SMP container and its packed bitumen to ensure homogeneous distribution and complete dissolution.

[0007] The objectives and advantages of the invention will become apparent from the following detailed description of preferred embodiments thereof in connection with the accompanying drawings.

Brief Description of the Drawings

[0008] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[0009] Fig. 1A shows a schematic view of a barrel configuration of soluble and meltable packing containers in accordance with certain embodiments of the present invention.

[0010] Fig. 1B shows a schematic view of a cylindrical configuration of soluble and meltable packing containers in accordance with certain embodiments of the present invention.

[0011] Fig. 1C shows a schematic view of a rectangular tank configuration of soluble and meltable packing containers in accordance with certain embodiments of the present invention.

[0012] Fig. 2A shows a cross sectional schematic diagram of the bitumen packing system in accordance with certain embodiments of the present invention.

[0013] Fig. 2B shows a top view schematic diagram of the bitumen packing system shown in Fig. 2A.

[0014] Fig. 3A shows a cross-sectional schematic diagram of the measured quantity dispenser module **205** with loaded bitumen in accordance with certain embodiments of the present invention.

[0015] Fig. 3B shows a cross-sectional schematic diagram of the measured quantity dispenser module **205** when the loaded bitumen is rejected in accordance with certain embodiments of the present invention.

[0016] Fig. 4A shows a cross-sectional schematic diagram of a packing container melting system in accordance with certain embodiments of the present invention.

[0017] Fig. 4B shows a top view schematic diagram of a packing container melting system as shown in Fig. 4A.

[0018] Fig. 4C shows sequential schematic diagrams of melting an SMP container using the packing container melting system as shown in Fig. 4A.

[0019] Fig. 5A shows a top view schematic diagram of a packing container melting system in accordance with certain embodiments of the present invention.

[0020] Fig. 5B shows a cross section schematic diagram of the packing container melting system shown in Fig. 5A.

[0021] Fig. 5C shows a cross sectional schematic diagram of the mixing submodule of the packing container melting system as shown in Fig. 5A.

[0022] Fig. 6A shows a cross sectional schematic diagram of a packing container melting system in accordance with certain embodiments of the present invention.

[0023] Fig. 6B shows a top view schematic diagram of the packing container melting system as shown in Fig. 6A.

[0024] Fig. 7A shows a cross sectional schematic diagram of a packing container melting system in accordance with certain embodiments of the present invention.

[0025] Fig. 7B shows a top view schematic diagram of the packing container melting system shown in Fig. 7A.

[0026] Fig. 7C shows an exploded view of the heat probe used in the packing container melting system as shown in Fig. 7A.

[0027] Fig. 7D shows sequential schematic diagrams using the packing container melting system shown in Fig. 7A for melting an SMP container.

[0028] Fig. 8A shows a cross sectional schematic diagram of a packing container melting system in accordance with certain embodiments of the present invention.

[0029] Fig. 8B shows a top view schematic diagram of the packing container melting system as shown in Fig. 8A.

[0030] Fig. 9 shows a perspective schematic diagram of a packing container handling system in accordance with certain embodiments of the present invention.

[0031] Fig. 10A shows a cross sectional schematic diagram of a packing container melting system in accordance with certain embodiments of the present invention.

[0032] Fig. 10B shows a top view schematic diagram of the packing container melting system as shown in Fig. 10A.

[0033] Fig. 10C shows sequential schematic diagrams of melting an SMP container with the packing container melting system as shown in Fig. 10A.

Detailed Description of the Invention

[0034] The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention.

[0035] Throughout this application, where publications are referenced, the disclosures of these publications are hereby incorporated by reference, in their entireties, into this application in order to more fully describe the state of art to which this invention pertains.

[0036] The present invention provides a soluble and meltable packing (SMP) container for packing and transportation of bitumen. The SMP container is soluble, meaning that all materials from the SMP container when melted are soluble in the bitumen, resulting in complete dissolution of the melted SMP container into the melted bitumen. The SMP container is meltable, meaning that it can be thermally melted together with the bitumen. Therefore, the SMP container produces zero waste, and is completely different from the conventional drums made from metal or other not thermally meltable materials. The SMP container eliminates not only the dead loss occurring in conventional drums, but also the expenses in disposal of the conventional drums.

[0037] In certain embodiments, the SMP container comprises:

[0038] a base polymer for providing tensile strength;

[0039] a dispersant polymer for providing lubricant to assist mould release; and

[0040] a soluble enhancer for enhancing the solubility of melted SMP container in bitumen.

[0041] In certain embodiments, the SMP container further comprises:

[0042] a filler utilized globally to increase the durability of bitumen (asphalt) mixture.

[0043] In certain embodiments, the base polymer is high density polyethylene (HDPE) in the range of 60 – 85%, preferably 60 - 70 w/w%. There are basically two grades of HDPE 300 and 500. The later provides better resistance against permanent deformation because of its higher stability and stiffening, relative to low flow. Grade 500 is 25% stronger and 12% harder than 300 grade so is preferred.

[0044] In certain embodiments, the dispersant polymer is polymer wax in the range of 5 – 15% w/w%, HDPE Polymer wax is preferred as it lowers viscosity and heightens the softening point as well as providing a mould release function.

[0045] In certain embodiments, the soluble enhancer is natural asphalt in the range of 10 - 5 w/w%. Natural asphalt with a specification: Ash content 1 – 5%, solubility 90 – 98%, softening point 180 – 230 °C and with a sulfur content of 3-6%.

[0046] In certain embodiments, the filler is calcium hydroxide, hydrated lime or both of them in the range of 10-15% w/w%.

[0047] The percentage of each component in the SMP container is dependent on the grade of the bitumen to be packaged. For packing the bitumen with the standard Penetration grade, AC and Performance Grade, the SMP container comprises:

[0048] HDPE in the range of 60-80 w/w%, preferably 60-70 w/w%;

[0049] polyethylene wax in the range of 5-15 w/w%, preferably 7 %w/w%;

[0050] calcium hydroxide also known as hydrated lime in the range of 10-15 w/w%, preferably 3-9 w/w%; and

[0051] natural asphalt (i.e. gilsonite) in the range of 10- 15 w/w%, preferably 10% w/w%.

[0052] One environmental advantage of using HDPE for the SMP container is that recycled non-food grade material can be utilized provided it was originally rotary molded. Previously blown HDPE is not suitable. HDPE is an ideal base material as it has a high tensile strength, high flexible modulus, non-leaching, UV resistant, resists most chemicals, durable and affordable.

[0053] Calcium hydroxide is utilized as a filler due to its low dollar value but high compatibility with Bitumen.

[0054] The SMP container gives a strong high tensile strength structure suitable for packing bitumen. Furthermore, mixing the melted SMP container with bitumen improves the resistance against permanent deformation of bitumen (asphalt) when used for paving roads.

[0055] In certain embodiments, the SMP container is formed by way of the rotary moulding techniques, for example, the rotary moulds disclosed by the same inventor of the present invention in Singapore Patent Application NO. SG10202004764Y.

[0056] In certain embodiments, the SMP container is strong enough to withstand the compressive load of being stacked to a height of at least two meters, when full, and at the same time melts and dissolves into the contained bitumen when heated to 140 to 160 °C.

[0057] Referring now to Fig.1A-C, there are provided the schematic views of the SMP containers in accordance with certain embodiments of the present invention. The barrel shapes are normally dimensioned such that four containers fit on a standard pallet. The square or rectangular shapes can have inbuilt channels to accommodate lifting by a forklift truck. The thickness of the containers is such that two containers full of bitumen can be stacked safely on top of each other.

[0058] As shown in Fig. 1A, the container **100** has a barrel configuration with two or more raised ribs (known as rolling rings) **101**, an aperture **102**, and a stopper or plug **103**, where the raised ribs **101** facilitates the container being rolled to a desired location, the aperture **102** allows product (e.g., bitumen) flow or be injected into the container, and the stopper or plug **103** seals the container **100**. The container **100** has a wall thickness that depends upon the material utilized to make the container **100**. In certain embodiments, the container **100** has a wall with a thickness of 3 to 5 mm, and a normal maximum capacity of 250 liters.

[0059] As shown in Fig. 1B, the container **105** has a cylindrical configuration with an aperture **108** and a stopper or plug **107**, where the aperture **108** allows product (e.g., bitumen) flow or be injected into the container, and the stopper or plug **107** seals the container **105**. The container **105** has a wall thickness that depends upon the material utilized to make the container **105**. In certain embodiments, the container **105** has a wall with a

thickness of 3 to 5 mm. The cylindrical configuration of the container **105** allows a maximum number of containers to be loaded into a standard 20ft shipping container.

[0060] As shown in Fig. 1C, the container **109** has a rectangular configuration with two or more slots **110**, one or more apertures **112** and one or more stoppers or plugs **113**, where the two or more slots **110** are built in the container to accommodate the lifting forks of a typical forklift truck, the one or more apertures **112** allow product (e.g., bitumen) flow or be injected into the container, and the one or more stoppers or plugs **113** seal the container **109**. The container **109** has a wall thickness that depends upon the material utilized to make the container **109**. In certain embodiments, the container **109** has a wall with a thickness of 5 to 7 mm.

[0061] The present invention provides a bitumen packing system in accordance with certain embodiments of the present invention. In principle, the bitumen packing system packs the bitumen that has been cooled to a predetermined temperature prior to injection. The bitumen packing system is especially useful to pack the bitumen into the SMP container as described above. It is to be noted that the bitumen packing system is also capable of packing bitumen into conventional drums; in this, avoided is the topping up step that is incurred when hot bitumen is introduced directly into the conventional drums where the hot bitumen is cooled.

[0062] Referring now to Fig. 2A and 2B, there are provided schematic diagrams of the bitumen packing system in accordance with certain embodiments of the present invention. As shown in Fig. 2A and 2B, the bitumen packing system **200** comprises:

[0063] a bitumen cooling tank **201** with a lid **202**; where the lid **202** seals the bitumen cooling tank **201** to be air tight; where the bitumen cooling tank **201** is fitted with a cooling means **210**; in certain embodiments, the cooling means **210** is a hollow steel coil through which a cooling medium, such as thermal oil, cold or iced water, glycol, etc., is pumped to reduce the temperature of the bitumen in which the coil is immersed; in certain embodiments, the hollow steel coil has a spiral configuration so as to guide the cooling medium from the inlet around the tank to the exit, resulting in maximized cooling effect; in certain embodiments, the bitumen cooling tank **201** is a double walled tank, where the cooling medium circulates in the void between the inner and outer walls of the bitumen cooling tank **201**, contributing to the cooling of the bitumen contained inside the tank;

[0064] an air valve **203** disposed in the upper portion of the bitumen cooling tank **201**, where the air valve **203** is fluidly coupled with an external air source to allow compressed air to be pumped into the bitumen cooling tank **201** if necessary to help expel the bitumen from the tank **201**;

[0065] an inlet isolation valve **204** disposed in the upper portion of the bitumen cooling tank **201**, where the inlet isolation valve **204** is fluidly coupled with an external hot bitumen source to allow hot bitumen to be pumped into the bitumen cooling tank **201**; in certain embodiments, the bitumen at the external hot bitumen source is kept at temperatures between 140 to 160 °C for distribution as it can be pumped at an acceptable rate at this temperature;

[0066] one or more measured quantity dispenser modules **205** disposed at the lower portion of the bitumen cooling tank **201**, where the one or more measured quantity dispenser modules **205** inject cooled bitumen into a packing container **208** that is positioned under the one or more measured quantity dispenser modules **205**; in certain embodiments, the one or more measured quantity dispenser modules **205** can be disposed at any circumferential position **206** of the bitumen cooling tank **201** as shown in Fig. 2B; Fig. 2B is the top view of the bitumen packing system, where the dispensers are shown as hidden detail i.e. dotted; and

[0067] a rotary table **209** disposed underneath of the measured quantity dispenser module **205**, where the packing container **208** is positioned on the rotary table **209**.

[0068] The bitumen packing system **200** further comprises a temperature probe **207** disposed in the lower portion of the bitumen cooling tank **201**; where the temperature probe **207** records the temperature of the cooled bitumen contained within the bitumen cooling tank **201**.

[0069] In operation, once reaching a desired temperature, the bitumen contained in the bitumen cooling tank **201**, by way of gravity, exits the bottom of the bitumen cooling tank **201** into the one or more measured quantity dispenser modules **205**. If the gravity feed is considered too slow, the bitumen cooling tank **201** is designed such that it can be pressurized through the air valve **203** to apply pressure to increase the flow from the bitumen cooling tank **201** to the one or more measured quantity dispenser modules **205**. If the bitumen is left too long in the bitumen cooling tank **201** and solidifies to a degree that will not easily flow to the one or more measured quantity dispenser modules **205**, a hot heating medium such as thermal oil or steam can be fed through the hollow coils and the void

between the two tank walls to raise the temperature of the bitumen to the desired minimum temperature.

[0070] Referring now to Fig. 3A and 3B, there are provided schematic diagrams of the measured quantity dispenser module **205** in accordance with certain embodiments of the present invention. As shown in Fig. 3A and 3B, the measured quantity dispenser module **205** comprises:

[0071] a bitumen holding body **301** holding a quantity of bitumen necessary to fill the packing container **208**;

[0072] a plunger **302** disposed on top of the bitumen holding body **301**, where when the plunger **302** is activated, it expels the bitumen held in the bitumen holding body **301** into the packing container **208**; in certain embodiments, the plunger **302** is a cylindrical plunger;

[0073] a hydraulic or pneumatic piston **303** disposed on top of the plunger **302** to push the plunger **302** to expel the bitumen;

[0074] a dispensing valve **304** disposed at the outlet of the bitumen holding body **301**, where when the dispensing valve **304** is open, it allows to fill the packing container **208**, and the dispensing valve **304** is closed immediately after filling; and

[0075] an outlet isolation valve **305** disposed between the bitumen cooling tank and the bitumen holding body **301**, where the bitumen cooling tank and the bitumen holding body are fluidly coupled so that the cooled bitumen from the bitumen cooling tank can be fed into the bitumen holding body **301**.

[0076] In operation, when the bitumen holding body **301** is full of bitumen as shown in Fig. 3A and a packing container **208** is placed under the bitumen holding body **301**, the plunger **302** is activated immediately after the dispensing valve **304** is opened. The plunger **302** is with a tight fit in the bitumen holding body **301**, forcing the bitumen out of the bitumen holding body **301** into the packing container **208** as shown in Fig. 3B. In certain embodiments, the plunger **302** is long enough to cut off the supply of cooled bitumen from the bitumen cooling tank **201** to the bitumen holding body **301**; when the plunger **302** is withdrawn and the dispensing valve **304** is closed, the cooled bitumen can again fill the bitumen holding body **301**.

[0077] In certain embodiments, the packing container is an SMP container as described above. Filling the SMP container entails cooling the bitumen down to a

temperature (50-80 °C) that will not affect the container's integrity. Most grades of Bitumen at this temperature are too viscous to be pumped so it has to be injected into empty containers.

[0078] The present invention provides a packing container melting system in accordance with certain embodiments of the present invention. Briefly, the packing container melting system comprises a melting tank that is provided with a heating means to melt an SMP container filled with packed bitumen, and a mixing means for ensuring that when the SMP container and its packed bitumen are melted, they are mixed to ensure homogeneous distribution and complete dissolution. The heating means can use hot liquid medium or electrical resistance heating.

[0079] In certain embodiments, the heating means comprises vertical heating probes and a heating outer metal ring so that it is capable of heating an SMP container filled with packed bitumen to a predetermined temperature (e.g., 150 °C minimum). The weight of the SMP container filled with packed bitumen forces the full container onto vertical heating probes. The heated vertical heating probes and heating outer metal ring ensure that the container sinks, where the heated vertical heating probes melt the bitumen contents and the heated outer metal ring melts the SMP container. When the SMP container and its packed bitumen are melted, they are mixed to ensure homogeneous distribution and complete dissolution.

[0080] In certain embodiments, the vertical heating probes also act as a mixer, whereby when the container and bitumen contents are liquified, the vertical heating probes act as a mixing blades when activated and rotate, ensuring homogeneous distribution and complete dissolution.

[0081] In certain embodiments, two or more melting tanks can be disposed in a common tank that is filled with heating medium, so that the two or more SMP containers filled with packed bitumen can be melted at the same time.

[0082] Referring now to Fig. 4A-C, there are provided schematic diagrams of a packing container melting system in accordance with certain embodiments of the present invention. As shown in Fig. 4A, 4B and 4C, the packing container melting system **400** comprises:

[0083] a double walled melting tank **401**, where an SMP container with fully loaded bitumen is melted; as shown in Fig. 4A and 4B, the double walled melting tank **401** has an inner wall and an outer wall, where the inner wall and the outer wall form a void between

them, and heating medium such as hot thermal oil or any other hot fluid can be pumped through the void;

[0084] a guide **402** with a funnel shape, where the guide **402** is disposed on the top of the melting tank **401** to assist centralization of the SMP container with fully loaded bitumen;

[0085] a first inlet connection **403** being fluidly coupled with the void of the doubled walled melting tank **401** and an external source of heating medium, where the first inlet connection **403** introduces the heating medium into the void of the double walled melting tank **401**;

[0086] a first outlet connection **404** being fluidly coupled with the void of the double walled melting tank **401** and an external reservoir for heating medium, where the first outlet connection **404** discharges the heating medium from the void of the double walled melting tank **401**; and

[0087] heating means **405** disposed within the melting tank **401** for melting the SMP container with fully loaded with bitumen.

[0088] In certain embodiments, the heating means **405** are heating hollow coils through which heating medium is pumped to melt the SMP container and its fully loaded bitumen; in certain embodiments, the heating hollow coils are thick-walled steel pipes, where the upper circumferences of the heating hollow coils are fitted with sharp leading ends. In certain embodiments, the heating hollow coil is fluidly coupled with a second inlet connection **406** that is in turn fluidly coupled with an external source of heating medium, and a second outlet connection **407** that is in turn fluidly coupled with an external reservoir for heating medium; where the second inlet connection **406** introduces the heating medium into the heating hollow coils, and the second outlet connection **407** discharges the heating medium from the heating hollow coils into the external reservoir.

[0089] In operation, as shown in Fig. 4C, when an SMP container with fully loaded bitumen is placed into the melting tank **401** with the help of the guide **402** and on top of the hot sharp-capped heating hollow coils, the SMP container sinks down gradually. The SMP container and its contents are rapidly melted by the heating means inside the double walled melting tank **401** and hot circumferential heating medium being circulated within the void formed by the inner and outer walls of the double walled melting tank **401**. The weight of the packing container and its contents and the rising hot bitumen ensure that the packing

container is fully immersed into the now hot bitumen and heating hollow coils. In certain embodiments, the packing container melting system **400** utilizes a heating medium heated to approximately 180°C.

[0090] Referring now to Fig. 5A-C, there are provided schematic diagrams of a packing container melting system in accordance with certain embodiments of the present invention. As shown in Fig. 5A, 5B and 5C, the packing container melting system **500** comprises:

[0091] an insulated common heating tank **501**;

[0092] a plurality of single walled tanks **502** (top view of 4 tanks shown in Fig. 5A) disposed in the insulated common heating tank **501**, the common heating tank **501** is filled with a thermal heating medium which heats the outer surface of the individual tanks **502**, the heating medium enters the common heating tank **501** through the inlet valve **510** and exits via outlet valve **511**, where each of the plurality of single walled tanks **502** is equipped with a heating means, an inlet connection **503** for supplying heating medium to the heating means **513**, and an outlet connection **504** for discharging the heating medium after the heating medium has passed the heating means; it is to be noted that the heating means, inlet connection **503**, and outlet connection **504** are similar to the heating means **405**, the second inlet connection **406**, and the second outlet connection **407** respectively as described in related to Fig. 4A; in certain embodiments, the heating means are as described above for carrying the heating medium at up to 180°C;

[0093] one or more discharge valves **505** disposed at the bottom of the insulated common tank **501** for discharging the melted packing container and bitumen;

[0094] a common holding tank **506** for holding the melted packing container and bitumen discharged from the plurality of single walled tanks **502**;

[0095] a common holding tank discharge valve **507** disposed at the bottom of the common holding tank **506**, where the common holding tank discharge valve **507** controls the discharge of the melted packing container and bitumen from the common holding tank **506**;

[0096] a recirculation pump **508** fluidly coupled with the common holding tank discharge valve **507**;

[0097] a mixer **509** fluidly coupled with the recirculation pump **508**, where the mixer **509** mixes the melted packing container and bitumen and discharges back to the common holding tank **506**.

[0098] In operation, the plurality of single walled tanks **502** with individually equipped heating means can be mounted in the insulated common tank **501**. In this configuration, there is no need for individual tanks to have double walls, and the melted product is drained off to a common holding tank. The product in the common holding tank is circulated through a mixer to ensure a homogeneous mix of the bitumen and drum material.

[0099] Referring now to Fig. 6A and 6B, there are provided schematic diagrams of a packing container melting system with inbuilt mixing system whereby the heating elements **611** act as the mixer blades in accordance with certain embodiments of the present invention. As shown in Fig. 6A and 6B, the packing container melting system **600** comprises:

[00100] an insulated common heating tank as described in relation to Fig. 5A;

[00101] a plurality of single walled tanks (top view of 4 tanks shown in Fig. 6B) disposed in a common holding tanks with an inlet valve **609** and outlet valve **610**;

[00102] heating means **611** as described in relation to Fig. 5A;

[00103] a common drive belt system **608** to rotate the heating elements;

[00104] a plurality of internal high temperature resistant swivel joints **601** and a plurality of external high temperature resistant swivel joints **602**, where each of the plurality of swivel joints **601**, **602** is disposed to each of the plurality of single walled tanks fitted with heating hot fluid elements such as coils inside the single walled tanks, and permits the coils to rotate when driven by the drive belt **608**; where each of the plurality of high temperature resistant swivel joints **602** allows the incoming heating medium from the hot fluid input pipe **603** to be introduced into the tanks, and each of the high temperature resistant swivel joint **602** allows the out-going heating medium to be discharged from the tanks through the hot fluid return pipe **604**, whereby each of the plurality of incoming and out-going heating medium pipes **603**, **604** are sealed by a sealing means **607** at the aperture going into the tank **502**;

[00105] a belt drive unit **605**, where the belt drive unit **605** comprises a motor and a gearbox for driving the plurality of swivel joints **601**, **602**; in certain embodiments, the belt drive unit **605** has a configuration as shown in **606**; and

[00106] a bitumen product discharge valve **612** disposed at the lower portion of the singled walled tank for discharging the mixed melted packing container and bitumen.

[00107] In operation, the heating means such as coils **611** is also utilized as mixers. A group of four of the combined heater mixers as shown are driven with the belt drive unit **605**.

[00108] Referring now to Fig. 7A-D, there are provided schematic diagrams of a packing container melting system in accordance with certain embodiments of the present invention. As shown in Fig. 7A, 7B, 7C and 7D, the packing container melting system comprises:

[00109] a single walled tank **701** with a guide **702**; in certain embodiments, the single walled tank **701** and guide **702** are made of metal;

[00110] a tank heating belt **703** disposed around the single walled tank **701** and powered by electricity;

[00111] a steel probe **704** with a pointed leading end, where the steel probe **704** is disposed within the single walled tank **701**; in certain embodiments, the steel probe **704** is made from a thick steel pipe with a thickness in the range of 10-25mm;

[00112] a cartridge heating element **705** being disposed within the steel probe **704**; and

[00113] a bitumen discharge valve **706** being disposed at the lower portion of the single walled tank **701**.

[00114] In operation, the sharp pointed pipes are heated to a temperature between 160 and 180°C by way of the cartridge heating elements fitted inside the probes so when the SMP packing container filled with bitumen is placed in the single walled tank **701** and on top of the hot steel probe **704**, it sinks down into the bottom of the tank **701**. The SMP container and contents are rapidly melted by the steel probes **704** and the tank heating belt **703**. The weight of packing container and contents and the rising hot bitumen ensure that the packing container is fully immersed into the now hot bitumen and heating means.

[00115] Referring now to Fig. 8A and 8B, there are provided schematic diagrams of a packing container melting system in accordance with certain embodiments of the present invention. As shown in Fig. 8A and 8B, the packing container melting system comprises:

[00116] a plurality of single walled tanks **801**, where each of the plurality of single walled tanks **801** has a guide **802**;

[00117] a tank heating belt **803** disposed around each of the plurality of the single walled tank **801** and powered by electricity;

[00118] steel probes **804** with cartridge heating elements being disposed within the steel probes **804** as described in relation to Fig. 7A;

[00119] a thrust bearing **805** enabling the steel probes **804** mounted on a circular base to rotate;

[00120] a belt drive spindle **806**;

[00121] a rotary electrical connector **807**;

[00122] a product discharge valve **808**;

[00123] an electrical drive unit **809** for operating an individual heater / mixer;

[00124] a motor, gear box and drive belt spindle assembly **810**;

[00125] a drive belt **811**; and

[00126] a common base plate **812** on which the individual heaters / mixers are fixed.

[00127] In operation, a group of four of the combined heater mixers are shown driven with a common belt drive system. The four heaters are mounted in a common base plate. For individual heater the mixer can be driven by a motor and gear box arrangement shown circled by a cloud in this illustration.

[00128] Referring now to Fig. 9, there is provided a schematic diagram of a packing container handling system in accordance with certain embodiments of the present invention. As shown in Fig. 9, the packing container handling system **900** comprises:

[00129] a commercially available drum gripper **901** designed to carry four drums at any one time; and

[00130] a hoist and trolley arrangement **902** fitted over the groups of heaters.

[00131] In operation, the container handling system can handle a group of four containers at one time.

[00132] Referring now to Fig. 10A-C, there are provided schematic diagrams of a packing container melting system in accordance with certain embodiments of the present invention. As shown in Fig. 10A, 10B and 10C, the packing container melting system comprises:

[00133] a rectangular single walled melting tank **1001** disposed with steel probes as described in relation to Fig. 7A; in certain embodiments, the tank **1001** is made of steel;

[00134] a guide **1002** disposed on top of the melting tank **1001** for helping centralize an SMP packing container to be melted;

[00135] a heating belt **1003** powered by electricity; and

[00136] a bitumen discharge valve **1004** disposed at the lower portion of the tank **1001**.

[00137] In operation, the steel probes are heated to a temperature between 160 and 180°C by way of the cartridge heating elements fitted inside the steel probes so when the rectangular package filled with bitumen is placed in the rectangular single walled melting tank and on top of the hot sharp capped steel probes it sinks down into the bottom of the tank. The rectangular package and contents are rapidly melted by the elements and hot circumferential heater formed by the drum band heater. The weight of package and the rising hot bitumen ensures the package is fully immersed into the now hot bitumen and heating elements.

[00138] In certain embodiments, the size of the SMP containers is to be in general limited to 250 liters (250kg) for drums due to handling constraints and 5,000 liters /5 metric tons for square, rectangular, oblong and round but could be bigger only limited by the size that the Rotary mold system can produce.

[00139] The present invention provides a system for the packing of bitumen for transportation in cold form providing a zero waste solution. The packing material becomes part of the gross product resulting in additional revenue of approximately 3%.

[00140] While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the scope of the present invention. Accordingly, the scope of the present invention is defined by the appended claims and is supported by the foregoing description.

CLAIMS

What is claimed is:

1. A packing container melting system comprising:
a melting tank; and
a heating means disposed in the melting tank to melt a soluble and meltable packing (SMP) container; wherein the SMP container is packed with bitumen.
2. The packing container melting system of claim 1, wherein the melting tank is a double walled melting tank (401) with an inner wall and an outer wall; wherein a void is formed between the inner wall and the outer wall;
wherein the void of the doubled walled melting tank (401) is fluidly coupled with a first inlet connection (403) that is in turn fluidly coupled with an external source of heating medium; wherein the first inlet connection (403) introduces the heating medium into the void of the double walled melting tank (401);
wherein the void of the double walled melting tank (401) is fluidly coupled with a first outlet connection (404) that is in turn fluidly coupled with an external reservoir for heating medium; wherein the first outlet connection (404) discharges the heating medium from the void of the double walled melting tank (401); and
wherein the heating means (405) are heating hollow coils through which the heating medium is pumped to melt the SMP container and its packed bitumen.
3. The packing container melting system of claim 2, wherein the heating hollow coils are thick-walled steel pipes; wherein the upper circumferences of the heating hollow coils are fitted with sharp leading ends.
4. The packing container melting system of claim 2, further comprising:
a mixing means being disposed within the double walled melting tank (401), wherein when the SMP container and its packed bitumen are melted, the mixing means mixes the melted SMP container and packed bitumen to ensure that the melted SMP container is completely dissolved in the melted packed bitumen.

5. The packing container melting system of claim 1, further comprising an insulated common heating tank (501);

wherein the melting tank is comprised of a plurality of single walled tanks (502) disposed in the insulated common heating tank (501); wherein each of the plurality of single walled tanks (502) is equipped with the heating means, an inlet connection (503) for supplying heating medium to the heating means (513), and an outlet connection (504) for discharging the heating medium after the heating medium has passed the heating means (513);

wherein the insulated common tank (501) is provided one or more discharge valves (505) disposed at its bottom for discharging the melted packing container and bitumen;

wherein the packing container melting system further comprises:

a common holding tank (506) for holding the melted packing container and bitumen discharged from the plurality of single walled tanks (502);

a common holding tank discharge valve (507) disposed at the bottom of the common holding tank (506), where the common holding tank discharge valve (507) controls the discharge of the melted packing container and bitumen from the common holding tank (506);

a recirculation pump (508) fluidly coupled with the common holding tank discharge valve (507); and

a mixer (509) fluidly coupled with the recirculation pump (508), where the mixer (509) mixes the melted packing container and bitumen and discharges back to the common holding tank (506).

6. The packing container melting system of claim 5, further comprising:

a plurality of mixing means; at least one of the plurality of mixing means is disposed within one of the plurality of single walled tanks (502), wherein when the SMP container and its packed bitumen are melted, the mixing means mixes the melted SMP container and packed bitumen to ensure that the melted SMP container is completely dissolved in the melted packed bitumen.

7. The packing container melting system of claim 1, further comprising an insulated common heating tank (501);

wherein the melting tank is comprised of a plurality of single walled tanks (502) disposed in the insulated common heating tank (501); wherein each of the plurality of single walled tanks (502) is equipped with the heating means, an inlet connection (503) for supplying heating medium to the heating means (611), and an outlet connection (504) for discharging the heating medium after the heating medium has passed the heating means (611);

wherein the packing container melting system further comprises:

a plurality of internal temperature resistant swivel joints (601) and external temperature resistant swivel joints (602), wherein each of the swivel joints (601) and (602) is disposed to each of the plurality of single walled tanks to couple with the heating means (611);

a belt drive unit (605), wherein the belt drive unit (605) comprises a motor and a gearbox for driving the plurality of swivel joints (601) and (602); thereby when the plurality of swivel joints (601) and (602) are turning, the heating means (611) are driven into turning and mixing the melted SMP container and bitumen while permitting the heating medium flow through the heating means (611); and

a bitumen product discharge valve (607) disposed at the lower portion of the singled walled tank for discharging the mixed melted packing container and bitumen.

8. The packing container melting system of claim 7, wherein each of the plurality of swivel joints comprises:

a hot fluid input pipe (603) for inputting the heating medium into the single walled tanks; and

a hot fluid return pipe (604) for discharging the heating medium from the single walled tanks.

9. The packing container melting system of claim 1, wherein the melting tank is a single walled tank (701) with a guide (702);

wherein the single walled tank (701) is disposed a tank heating belt (703) around and powered by electricity;

wherein the heating means are steel probes (704) with a pointed leading end; wherein the steel probes (704) are disposed within the single walled tank (701);

wherein the steel probes (704) are disposed of cartridge heating elements (705) inside; and

wherein the lower portion of the single walled tank (701) is disposed a bitumen discharge valve (706) for discharging the melted container and bitumen.

10. The packing container melting system of claim 1, wherein the melting tank is comprised of a plurality of single walled tanks (801), where each of the plurality of single walled tanks (801) has a guide (802);

wherein each of the plurality of the single walled tank (801) is disposed a tank heating belt (803) around and powered by electricity;

wherein the heating means are steel probes (804) with cartridge heating elements being disposed within the steel probes (804);

wherein the packing container melting system further comprises:

a thrust bearing (805) enabling the steel probes (804) mounted on a circular base to rotate;

a belt drive spindle (806);

a rotary electrical connector (807);

a product discharge valve (808);

an electrical drive unit (809) for operating an individual heater/mixer;

a motor, gear box and drive belt spindle assembly (810);

a drive belt (811); and

a common base plate (812) on which the individual heaters/mixers are fixed.

11. A bitumen packing system comprising:

a bitumen cooling tank (201) with a lid (202);

a cooling means (210) being fitted into the bitumen cooling tank (201), wherein the cooling means cools the bitumen in the bitumen cooling tank via a cooling medium;

an air valve (203) disposed in upper portion of the bitumen cooling tank (201);

wherein the air valve (203) is fluidly coupled with an external air source to allow compressed

air to be pumped into the bitumen cooling tank (201) if necessary to help expel the bitumen from the bitumen cooling tank (201);

an inlet isolation valve (204) disposed in upper portion of the bitumen cooling tank (201); wherein the inlet isolation valve (204) is fluidly coupled with an external hot bitumen source to allow hot bitumen to be pumped into the bitumen cooling tank (201); and

one or more measured quantity dispenser modules (205) disposed at lower portion of the bitumen cooling tank (201); wherein the one or more measured quantity dispenser modules (205) inject cooled bitumen into a packing container (208) that is positioned under the one or more measured quantity dispenser modules (205).

12. The bitumen packing system of claim 11, wherein the cooling means (210) is a hollow steel coil through which the cooling medium is pumped to reduce the temperature of the bitumen.

13. The bitumen packing system of claim 12, wherein the hollow steel coil has a spiral configuration so as to guide the cooling medium from an inlet around the tank to an exit.

14. The bitumen packing system of any of claims 11-13, wherein the bitumen cooling tank (201) is a double walled tank with an inner wall and an outer wall, wherein the cooling medium circulates in void between the inner and outer walls.

15. The bitumen packing system of any of claims 11-14, wherein the cooling medium is selected from the group consisting of thermal oil, cold or iced water, and glycol.

16. The bitumen packing system of any of claims 11-15, further comprising a rotary table (209) disposed underneath of the measured quantity dispenser module (205); and wherein the packing container (208) is positioned on the rotary table (209).

17. The bitumen packing system of any of claims 11-16, wherein the measured quantity dispenser module (205) comprises:

a bitumen holding body (301) holding a quantity of bitumen necessary to fill the packing container (208);

a plunger (302) disposed on top of the bitumen holding body (301); wherein when the plunger (302) is activated, it expels the bitumen held in the bitumen holding body (301) into the packing container (208);

a hydraulic or pneumatic piston (303) disposed on top of the plunger (302) to push the plunger (302) to expel the bitumen;

a dispensing valve (304) disposed at the outlet of the bitumen holding body (301); wherein when the dispensing valve (304) is open, it allows to fill the packing container (208), and the dispensing valve (304) is closed immediately after filling; and

an outlet isolation valve (305) disposed between the bitumen cooling tank and the bitumen holding body (301); wherein the bitumen cooling tank and the bitumen holding body are fluidly coupled so that the cooled bitumen from the bitumen cooling tank can be fed into the bitumen holding body (301).

18. The bitumen packing system of any of claims 11-17, wherein the packing container is a soluble and meltable packing (SMP) container.

19. A soluble and meltable packing (SMP) container comprising:
a base polymer for providing tensile strength;
a dispersant polymer for providing lubricant to assist mould release; and
a soluble enhancer for enhancing the solubility of melted SMP container in bitumen.

20. The SMP container of claim 19, further comprises a filler with compatibility with bitumen.

21. The SMP container of claim 19 or 20, wherein the base polymer is high density polyethylene (HDPE) in the range of 60-85 w/w%.

22. The SMP container of any of claims 19-21, wherein the dispersant polymer is polymer wax in the range of 5-15 w/w%.

23. The SMP container of any of claims 19-22, wherein the soluble enhancer is natural asphalt in the range of 10-15 w/w%.

24. The SMP container of any of claims 19-23, wherein the filler is calcium hydroxide, hydrated lime, or both in the range of 10-15 w/w%.