



## PATENTED METHODS FOR SELECTIVE EXTRACTION

Patented methods for selective extraction that enable the recovery of viscous petroleum products or high-viscosity vegetable oils from tanks with the quality required for on-site consumption or for sale to other consumers, using equipment that causes contaminants to precipitate and segregate at the bottom of tanks. They are also applied to the cleaning of tanks, pipes and process equipment, offering important advantages over alternative methods.



# APPLICATIONS OF THE PATENTED METHODS

The patented selective extraction methods are applied in refineries, biofuel plants, petrochemical plants, power generation plants, metallurgical plants, shipyards, port terminals and other facilities with the following equipment:

**Tanks containing fuel oil or other viscous petroleum products.** Selective extraction that generates large profits by recovering viscous petroleum products with the quality required for on-site consumption or for sale in compliance with legal specifications. In addition, it is possible to clean the tank over its full height with minimal waste generation and clean its associated pipes.

**Vegetable oil tanks.** Selective extraction of high-viscosity vegetable oils used for the production of biofuels, mainly sustainable aviation fuels (SAF). The selective extraction of viscous oils such as used cooking oil (UCO) and crude palm oil (CPO) enables most of the oil to be recovered with the quality required for on-site consumption. In addition, it is possible to clean the tank over its entire height with minimal waste generation and clean its associated pipes.

**Ship tanks.** Emptying and cleaning of ship tanks with maximum safety, minimal waste generation and cleaning results suitable for hot work in shipyards or changing the product to be transported.

**Molten salt tanks.** Dissolution and cleaning of the salts that have solidified at the bottom and those adhered to the walls of the tank over their entire height, under safe conditions and with minimal waste generation. Molten salts are used for energy storage in solar thermal power plants, wind farms and other power generation plants, including molten salt nuclear reactors.

**Pipes.** Emptying and cleaning of pipes using steam ejectors that inject large flows of steam into the pipes, homogeneously mixed with air through turbulent diffusion, with total safety (< 0.5 bar), minimal waste generation and excellent cleaning results.

**Process units and equipment.** Emptying and cleaning of process units and equipment (reactors, air coolers, demisters, etc.) by means of steam ejectors that inject and recirculate large flows of steam homogeneously mixed by turbulent diffusion with air or nitrogen.



# SPECIFIC EQUIPMENT FOR APPLYING THE PATENTED METHODS

The patented selective extraction methods use the following specific equipment in their various applications:

- **Steam ejectors** that reduce the viscosity of the hydrocarbons or oils in the tank and facilitates their extraction. Steam ejectors suck gases from the tank by the Venturi effect, mixes them homogeneously with its motive steam in a turbulent diffusion process, and injects the homogenized gases into the tank (see in the lower left photograph the gray flexible hose for gas suction from the tank and the red flexible hose for hot gas injection in the tank). Gas homogenization enables the heating of the surface layer of hydrocarbons or oils (necessary for selective extraction) and the uniform heating of the tank over its entire height (necessary for cleaning the internal walls of the tank).
- **Perimetral heating conduits** attached externally to the tank (see the perimetral conduit marked by red arrows in the lower center photograph), which, by reducing the viscosity and density of hydrocarbons or oils, cause free water and contaminating solids to precipitate at the bottom of the tank. Therefore, the perimetral conduits act as pre-decanters that reduce the percentage of water in hydrocarbons or oils and as large filters for retaining solids by precipitation. Another important function of perimetral conduits in tanks containing highly viscous vegetable oils is to thermally connect the line of the tank used for selective extraction with the heating coils of the tank or other heating devices installed within it, which greatly facilitates the extraction of the highly viscous vegetable oil.
- **ATEX gas heaters** connected to centrifugal fans (see the lower right photograph), which inject very hot air into the tank to reduce the viscosity of the surface layer of hydrocarbons and cause them to flow towards the pump that selectively extracts them. Gas heaters are less effective than steam ejectors and, furthermore, carry the risk of polymerization of the vegetal oil adhering to the walls of the tank because degraded triglycerides react with one another to form giant molecular chains, giving rise to a gummy, viscous or hardened layer that is very difficult to remove.



# ADVANTAGES OF THE SELECTIVE EXTRACTION PATENTS (1)

The patented selective extraction methods have the following advantages over alternative methods:

- ✓ **Significant profits are generated by extracting hydrocarbons or oils with higher quality.** The patented selective extraction methods generate significant profits by recovering high-viscosity hydrocarbons or vegetable oils from tanks with the required quality for sale to third parties or on-site consumption, using equipment that causes contaminants to precipitate and segregate at the bottom of the tank. The precipitation of contaminants is achieved by installing perimetral heating conduits (see the two lower left photographs) which, by reducing the viscosity and density of the hydrocarbons or oils through heating, cause the contaminants to precipitate at the bottom of the tank. The segregation of contaminants at the bottom of the tank is achieved by heating the surface layer of hydrocarbons or oils, which causes a selective flow of the higher-quality surface hydrocarbons or oils towards the extraction pump, after passing close to the perimetral heating and precipitation conduits. The surface layer is heated using steam ejectors or gas heaters. Steam ejectors homogenize steam with gases sucked from the tank through turbulent diffusion, which prevents the free upward movement of steam within the tank, despite having a lower density than air, thereby exceptionally increasing the proportion of injected steam that condenses on the surface layer of hydrocarbons or oils, with the consequent transmission of large amounts of latent heat (539.4 cal/g at 100 °C). In contrast, this latent heat would not be transferred to the surface layer if steam were injected directly into the tank, as it would rise rapidly and would inefficiently transfer its latent heat to the tank roof.
- ✓ **Waste generation is minimized.** The recovery of hydrocarbons or oils from tanks with the quality required for sale or consumption eliminates the need to manage them as waste. On the contrary, by using alternative methods the high-quality product could not be separated from the more contaminated product and would have to be managed as waste. In addition, the cleaning of the internal walls of the tank over their entire height is carried out simultaneously with selective extraction, resulting in a considerable reduction of waste from tank cleaning.



## ADVANTAGES OF THE SELECTIVE EXTRACTION PATENTS (2)

- ✓ **The cost of cleaning tanks, pipes and process equipment is greatly reduced.** The patented methods simplify cleaning and minimize waste generation, thereby greatly reducing its cost, particularly in facilities that make their plant steam available for cleaning work, which is quite common. The steam ejectors used in the final stage of selective extraction, in addition to reducing viscosity and facilitating the extraction of hydrocarbons or oils from the bottom of the tank, heat the tank uniformly over its entire height (80–90 °C), which, together with the turbulence of the injected gases, causes the hydrocarbons or oils adhering to the walls of the tank to detach. This makes it possible to carry out the cleaning of the internal walls of the tank over their entire height simultaneously with selective extraction, achieving a degree of cleanliness suitable for hot work or for changing the product stored in the tank. Steam ejectors homogenize the mixture of steam and gases that they inject into tanks through turbulent diffusion, which prevents the free upward movement of steam and allows uniform heat transmission over the entire height of the tank (see the lower right photograph showing how the homogeneous mixture of injected gases remains close to the bottom of the tank). On the contrary, if steam were injected directly, heat would not be transmitted uniformly throughout the tank, as its lower density and higher temperature, compared to the homogeneous mixture of steam and air, would cause it to rise rapidly and inefficiently transfer its latent heat to the tank roof when condensing. The patented methods also offer significant advantages when cleaning pipes and process equipment, as described on page 2 of this document (see in the lower left photograph a steam ejector cleaning a pipe connected to the tank).
- ✓ **Improved health and safety conditions for workers.** Selective extraction is performed entirely without workers inside the tank, and steam ejectors clean the walls of the tank over their entire height, without the need for scaffolding or lifting platforms and without workers inside the tank. In addition, steam ejectors saturate the tank with steam, creating additional safety conditions regarding fire and explosion risks.



## ADVANTAGES OF THE SELECTIVE EXTRACTION PATENTS (3)

The lower left photograph shows that the homogeneous mixture of steam and air injected at low pressure by the steam ejector (< 0.1 bar) remains close to the bottom of the tank, whereas the lower right photograph shows that the steam injected at a much higher pressure by the steam boiler (6 bar) rises rapidly because it has a lower density and a higher temperature than the homogeneous mixture of steam and air in the lower left photograph.

In this way, steam ejectors achieve a much higher heat transfer to the surface layer of petroleum products or vegetable oils in the tank, which reduces their viscosity and causes them to flow towards the extraction pump, after passing alongside the perimetral heating and precipitation conduit, whereas the steam injected by the boiler would rise rapidly and inefficiently transfer its latent heat to the tank roof (539.4 cal/g at 100 °C).

Furthermore, steam ejectors transmit heat uniformly over the entire height of the tank or equipment and also generate turbulence, so that the walls of the tank or equipment are cleaned over their entire height. Steam ejectors also generate turbulence and very high flow velocity within pipes, resulting in a much greater range and cleaning effectiveness than what is achieved by injecting the steam from the boiler directly into pipes.



# SALE OF THE SELECTIVE EXTRACTION PATENTS

SOLVENTEC offers to transfer ownership of international patents or grant operating licences to interested companies. Once the transfer of ownership or the granting of licences has been confirmed, SOLVENTEC will provide technical advice to companies that purchase the patents or licences, including supervision of the initial projects and the supply of the specific equipment required to carry out selective extraction and cleaning work. The selective extraction patents for sale are as follows:

- ✓ **SYSTEM AND METHOD FOR THE SELECTIVE EXTRACTION OF VISCOUS HYDROCARBONS FROM TANKS AND OTHER CONTAINERS.** International patents were applied for via the PCT (Patent Cooperation Treaty) and were granted in Europe and the main countries of America, Asia and Africa. Application PCT/ES2021/070396 was filed on 2 June 2021, so the international patents will remain in force until 2 June 2041. These patents also apply to the cleaning tanks, pipes and process units.
- ✓ **METHOD FOR SELECTIVE EXTRACTION OF HIGHLY VISCOUS OR SOLIDIFIED OILS FROM STORAGE TANKS.** International patent applications via the PCT will be filed in Europe and in all other countries where it is decided to protect the invention (the PCT currently has 158 contracting states). Application PCT/ES2025/070437 was filed on 15 July 2025, so the international patents will remain in force until 15 July 2045. The European Patent Office (EPO) has issued a favourable international search report, as the invention meets the requirements of novelty, inventive step and industrial applicability (International Publication: WO/2026/017925, dated 22 January 2026). This invention is characterized by operations that thermally connect the line of the tank used for the selective extraction with the heating coils of the tank or other heating devices installed within it, which extends the scope of the previous invention to tanks containing highly viscous products where it is extremely difficult to lower the fill level sufficiently to enable the necessary opening of their manholes, as occurs in tanks whose heating coils are inoperative due to perforations or in UCO (Used Cooking Oil) tanks with accumulations of practically solidified fats at their bottoms.

