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Washing method for centrifugal separators of mixtures composed of two liquid phases and solid and non-solid sediments

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Abstract

The present invention refers to a washing method for centrifugal separators of mixtures composed of two liquid phases with different specific gravity and solid and non-solid sediments.

The said method includes two washing phases and one phase is performed keeping the overflow opening for the exit of the liquid phase with higher specific gravity closed.

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COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title:

Washing method for centrifugal separators of mixtures composed of two liquid phases and solid and non-solid sediments

The following statement is a full description of this invention including the best method of performing it known to us:-

The present patent application for industrial invention refers to a washing method for centrifugal separators, known as "disk centrifugal separators" for separation of mixtures composed of two liquid phases and solid and non-solid sediments.

The said separators are normally used to separate mixtures composed of two liquids with different specific weight, which are respectively the "light phase" and the "heavy phase"; the heavy phase is sometimes the residual product obtained from processing with respect to the more valuable light phase.

A typical application of the said separators is found in oil industry, where the liquid to be separated, normally known as "oil wort", is centrifugated to extract the valuable oil component depurated from aqueous phase and solid sediments.

Separation takes place because of the different specific gravity of the two liquid phases that, because of centrifugal acceleration, tend to be positioned on two radial layers, whose interface theoretically coincides with a cylindrical surface on which the heavy phase is collected externally, and the light phase is concentrated internally.

In order to understand the solutions and advantages offered by the washing method of the invention, this description continues illustrating the operating principles of centrifugal separators with vertical axis, which are basically composed of a feed conduit with vertical axis ending into a column distributor, being an integral part of a drum that rotates around the said conduit and supports a stack of diaphragms with spacers, consisting in a closed and overlapped series of lamellar disks with truncated-conical profile, which make separation of the two liquid phases easier, favouring the formation of a laminar flow through the spaces of the stack of diaphragms.

During processing a preferably constant amount of mixture is dropped or introduced continuously in the feed conduit by means of a feed pump, goes through the distribution column and inundates the drum, including the area with lamellar disks.

The solid sediments and the heavy phase stratify in the peripheral area of the drum because of centrifugation and the light phase occupies the

internal area.

The product continues phase separation while passing through the area with lamellar disks.

More precisely, the heavy phase and the solid sediments migrate towards the peripheral area, sliding on the lower surface of the lamellar disks, and the light phase occupies the centre of the drum, sliding on the upper surface of the lamellar disk, thus forming three layers inside the rotating drum: one external layer made of solid sediments, one intermediate layer made of the heavy phase and one internal layer made of the light phase, being the three phases separated by two interfaces, theoretically composed of two vertical cylindrical surfaces coaxial with the drum.

The two liquid phases formed inside the drum are divided by a partition positioned on the opposite side with respect to the side where the product is introduced in the drum from the bottom of the distribution column and basically composed of a bell that rotates with the drum, whose peripheral border creates a reverse overflow with is overridden by the heavy phase directed towards the annular area formed by the bell.

The bell divides the drum in two sections, thus creating two communicating vessels: the heavy phase on one side, the heavy phase on the other side and the light phase inside.

The solid sediments stratify on the bottom of the vessels, which corresponds to the peripheral area of the drum.

Because of radial stratification of the two liquid phases, the liquid phases can be extracted from the drum by means of annular openings, with straight and free overflow, separated and positioned on top of the drum in external position with respect to the feed conduit with vertical axis; more precisely, the heavy phase is extracted continuously through a first opening and the light phase is extracted continuously through a second opening situated at a lower distance from the drum rotation axis with respect to the first opening.

In other words, it can be said that the two overflow openings are situated at two different radial levels to intercept the free surfaces of the two liquid phases that are positioned on completely different radial levels due to

a more intense centrifugal field than the gravity field.

The drum is normally provided with peripheral openings with sub-radial direction that are normally closed and opened during the rotation of the drum in order to eject the solid sediments with the liquid mass inside the drum by centrifugation.

This structure of the drum is particularly used in applications where the product to be separated contains a considerable quantity of solid sediments; this version of the drum is defined as "automatic discharge" drum.

When the drum is not provided with the said openings, the drum is defined as "manual discharge" drum, meaning that sediments can be only removed by stopping the separator and dismounting the drum.

In both types of drums, before performing the automatic ejection or manual removal of sediments, the valuable liquid phase must be extracted from the drum, in order not to waste it.

In particular, during manual discharge (i.e. drum without openings), manual cleaning is completely performed on the drum and on each lamellar disk.

The automatic discharge (i.e. drum with openings) is performed to restore the best operating conditions of the separator. Therefore, once sediments are ejected, periodical cleaning is required to remove all sediments (normally dirtying agents) that are not automatically discharged and are trapped in the small gaps of the drum and of the stack of lamellar disks.

In order to ensure complete cleaning, the "automatic discharge" drum is periodically opened (at the end of working day or week, according to the dirtying characteristics of the product being processed) to clean each disk manually, as in the case of drums without openings.

This operation requires considerable labour and machine shutdown.

The need to periodically perform complete cleaning of the drum has no other solution, with the type of disk centrifugal separators in which the liquid phases (or the heavy phase only) are ejected by means of free overflow openings.

This type of machine does not permit the washing procedure known as CIP (cleaning in place), which allows to wash the drum without dismounting it, while the machine is in operation, because the lamellar disks are not subjected to the washing flow.

The CIP of the drum, either of automatic or manual discharge type, is a complete cleaning operation of the drum, with special reference to the lamellar disks, performed introducing a washing liquid flow, possibly with added detergent, or an alkaline or acid solution into the feed conduit.

The mechanical washing action because of hydraulic turbulence is possibly associated with a chemical action based on the agents used.

Normally, it is performed with recirculation of the washing liquid, with final cleansing in order to guarantee a good result.

The essential condition for CIP is that the washing flow goes through the lamellar pack; this condition, however, cannot be achieved if the overflow opening of the heavy phase, that is to say the furthest one from the drum axis, is open, thus creating a preferential exit for the washing liquid, which cannot raise to wash the lamellar disks.

An increase of the inlet capacity in order to wash the disks would also cause an increase of capacity through the preferential exit, with great energy waste and no success.

Moreover, it must be noted that the capacity of the inlet flow is limited because of the reduced "radial jump" between the feed conduit and the position of the light phase opening; the said jump needs to be considerable to compensate the inevitable great load losses associated with a considerable flow through the drum, which would be however small and insufficient through the lamellar disks.

The purpose of the present invention is to provide a solution to all aforementioned disadvantages, introducing a new effective washing method of CIP type.

According to the method of the invention, washing is performed in two phases, regardless of their sequence, one dedicated to clean the internal peripheral areas of the drum, where sediment and heavy phase are stratified, and one dedicated to clean the central areas, and particularly the

lamellar disks.

According to the method of the invention, the washing phase dedicated to clean the internal peripheral areas of the drum is performed keeping both overflow openings open; evidently, the washing liquid flows off from the overflow opening situated at the furthest distance from the rotation axis of the drum.

According to the new method of the invention, the washing phase dedicated to clean the central areas of the drum is performed keeping the overflow opening situated at the furthest distance from the rotation axis of the drum closed and keeping the overflow opening situated at the closest distance from the rotation axis open, in such a way that the washing liquid is forced to go through the small spaces of the lamellar disks in centripetal direction and exit from the second overflow opening.

Evidently, the washing method of the invention requires the introduction of means used to intercept the flow exiting the overflow opening situated at the furthest distance from the rotation axis of the drum while the machine is in operation.

Any interception means can be used, such as cocks, gates or obturating disks of the type used in some models of centrifugal separators to favour the correct emptying of the drum and recuperate the light phase contained in the drum, before the periodical removal of the sediments laid against the walls of the drum.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1) Washing method for centrifugal separators of mixtures composed of two liquid phases with different specific gravity, and solid and non-solid sediments, of the type comprising a rotating drum with a stack of lamellar disks used to separate the liquid phases, one being a "heavy" phase and one being a "light" phase, which are continuously extracted through two different overflow openings – of which at least the opening used for the exit of the heavy phase is a free overflow opening – situated respectively at a different distance from the rotation axis of the drum, characterised in that it includes two washing phases, regardless of their sequence:

a – one phase dedicated to internal cleaning of the drum, particularly the most peripheral areas, in which both overflow openings are kept open;

b - one phase dedicated to internal cleaning of the drum, particularly the central areas and specifically the stack of lamellar disks, in which the overflow opening situated at the furthest distance from the rotation axis of the drum is kept closed with ordinary interception means and the overflow opening situated at the closest distance from the rotation axis of the drum is kept open, in such a way that the washing flow is forced to go through the small spaces of the lamellar disks in centripetal direction and exit from the second overflow opening situated at the closed distance from the rotation axis of the drum.

2) Washing method as defined in the previous claim, characterised in that the interception means are closed during the drum rotation.

3) Washing method as defined in the first or both claims, characterised in that during the washing phase illustrated the first claim under b), the overflow opening situated at the furthest distance from the rotation axis of the drum is closed by means of the same obturating disk, normally used in some centrifugal separators of known type to favour the correct emptying of the drum, recuperating the light phase contained in the drum, before performing

the "manual discharge" or "automatic discharge" phase of the sediments laid against the internal walls of the drum.

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