Continuous treatment of ~~soot~~ water containing carbon black

[0001] The invention relates to a process for the continuous treatment of soot water that arises from the partial oxidation of heavy-metal-containing liquid hydrocarbons.

[0002] A high-temperature process such as the partial oxidation of heavy-metal-containing liquid hydrocarbons generates dispersed soot that is predominantly discharged from the process by scrubbing the soot-containing raw gas with water. The soot water contains up to approximately 2% soot and this soot contains heavy metals, mainly nickel and vanadium.

[0003] After scrubbing, the soot water has a temperature of between 150°C and 300°C and a pressure of 40 to 85 bar. Generally, it is passed through a pressure-reducing device and a cooler in order to obtain soot water in an atmospheric state with an acceptable temperature so that it can be further treated. Although the soot water contains a high percentage of water, it has a highly viscous consistency and the soot hardly precipitates. Dewatering of the soot water is thus highly complex. In practice, the soot water is usually collected in tanks and later subjected to filtration. This is a batch process, the water separated off via the filtration being heated as process water and recycled to the process, with the remaining residues being deposited in tanks for further processing.

[0004] DE 40 03 242 A1 describes a process for separating soot from soot water in which the soot water is mixed with sludge at a sludge treatment plant, with a dewatering agent, such as organic flocculant, being added before the soot water undergoes filtration. This process requires large amounts of dewatering agents and a lot of space, which is a major economic burden.

[0005] DD 10 63 35 also describes a process for the treatment of soot water, in which a lime-containing suspension is added to cause sedimentation. In so doing, the soot water is subjected to a chemical process, meaning that the contaminated effluent cannot be recycled without further treatment.

[0006] Publication DE 4331322 A1 focuses on a process for separating unwanted materials from sludge at a sludge purification plant with settling basins and agitators. In the example application mention is made of the removal of soot and heavy metals downstream of a flue gas desulphurisation unit using a hydrocyclone for thickening. Due to the viscous, pasty quality of soot water arising from the partial oxidation of liquid hydrocarbons, hydrocyclones are unsuitable for use in the dewatering process.

[0007] The soot water can also be filtered off in batches. For this, large-volume stackable tanks are required upstream and downstream of the filtration unit; this, however, leads to higher costs than the continuous process.

[0008] Therefore, the invention is aimed at the problem of developing a process for the continuous treatment of soot water from the partial oxidation of heavy-metal-containing liquid hydrocarbons that is technically simpler and more economical from a cost point of view than the state of the art.

[0009] The invention achieves the objective via the following process for the continuous treatment of soot water that accumulates during the partial oxidation of heavy-metal-containing liquid hydrocarbons. In this process the soot water is drawn off from the gasification process at a temperature of 150°C to 300°C and a pressure of 40 to 85 bar, and passes through a pressure-reducing device to reduce the pressure to down to approximately 5 bar before it is centrifuged to a solids content of up to 10% at a pressure of up to 5 bar and a temperature of up to 150°C in a pre-dewatering step with no agents being added, a pasty soot sludge rich in heavy metals being obtained and a centrate that is low in heavy metals accumulating. This centrate is recycled, at least in part, to the gasification process as process water.

[0010] The soot water from the partial oxidation of heavy-metal-containing liquid hydrocarbons has a temperature of 150°C to 300°C and a pressure of 40 to 85 bar. It must first pass through a pressure-reducing device to reduce the pressure of up to approximately 5 bar. The soot water is cooled to 150°C by a cooler if the temperature of the soot water is over 150°C. The dewatering of the soot water is carried out in two steps. In a pre-dewatering step the soot water is passed through a centrifuge at a pressure of up to 5 bar and a temperature of up to 150°C without adding any agents, a viscous soot sludge rich in heavy metals and a centrate low in heavy metals being obtained. The soot sludge contains up to 10% solids. The centrate, which has not been contaminated with any additives, is for the most part recycled to the gasification process as process water. Before the process water that is to be recycled flows back into the gasification process, it is heated to 150°C if the temperature of the centrate is below 150°C. Due to the low temperature loss of the centrate during operation, the centrate also requires only slight reheating.

[0011] Some embodiments of the invention envisage the pre-dewatering being carried out using a sedimentation centrifuge, the sedimentation centrifuge being either a solid-bowl screw-type centrifuge or a disc centrifuge as these centrifuges can perform the dewatering of the soot water at a pressure of up to 5 bar and a temperature of up to 150°C.

[0012] In further embodiments of the invention the soot sludge, which is rich in heavy metals, is post-dewatered to a solids content of up to 20%. This is carried out using either continuously operated dewatering equipment, such as a belt filter press, or batchwise-operated dewatering equipment, such as a chamber filter press. The post-dewatering can also be carried out in a drying unit or a spray dryer. After pre-dewatering, the soot sludge can, of course, also be further dewatered in a multi-hearth furnace and subsequently incinerated.

[0007a] Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

[0007b] It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

[0008] A preferred object of the invention relates to developing a process for the continuous treatment of soot water from the partial oxidation of heavy-metal-containing liquid hydrocarbons that is technically simpler and more economical from a cost point of view than the state of the art.

[0008a] According to a first aspect of the invention there is provided a process for the continuous treatment of soot water that arises from the partial oxidation of heavy-metal-containing liquid hydrocarbons, the soot water being drawn off from the gasification process at a temperature of 150°C to 300°C and a pressure of 40 to 85 bar,

wherein the soot water passes through a pressure-reducing device to reduce the pressure to down to approximately 5 bar before it is centrifuged to a solids content of up to 10% at a pressure of up to 5 bar and a temperature of up to 150°C in a pre-dewatering step with no agents being added, a pasty soot sludge rich in heavy metals being obtained and a centrate that is low in heavy metals accumulating, the centrate then being recycled, at least in part, to the gasification process as process water.

[0008b] Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising", and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

[0009] The invention achieves at least the preferred objective via the following process for the continuous treatment of soot water that accumulates during the partial oxidation of heavy-metal-containing liquid hydrocarbons. In this process the soot water is drawn off from the gasification process at a temperature of 150°C to 300°C and a pressure of 40 to 85 bar, and passes through a pressure-reducing device to reduce the pressure to down to approximately 5 bar before it is centrifuged to a solids content of up to 10% at a pressure of up to 5 bar and a temperature of up to 150°C in a pre-dewatering step with no agents being added, a pasty soot sludge rich in heavy metals being obtained and a centrate that is low in heavy metals accumulating. This centrate is recycled, at least in part, to the gasification process as process water.

[0010] The soot water from the partial oxidation of heavy-metal-containing liquid hydrocarbons has a temperature of 150°C to 300°C and a pressure of 40 to 85 bar. It must first pass through a pressure-reducing device to reduce the pressure of up to approximately 5 bar.

The soot water is cooled to 150°C by a cooler if the temperature of the soot water is over 150°C. The dewatering of the soot water is carried out in two steps. In a pre-dewatering step the soot water is passed through a centrifuge at a pressure of up to 5 bar and a temperature of up to 150°C without adding any agents, a viscous soot sludge rich in heavy metals and a centrate low in heavy metals being obtained. The soot sludge contains up to 10% solids. The centrate, which has not been contaminated with any additives, is for the most part recycled to the gasification process as process water. Before the process water that is to be recycled flows back into the gasification process, it is heated to 150°C if the temperature of the centrate is below 150°C. Due to the low temperature loss of the centrate during operation, the centrate also requires only slight reheating.

[0011] Some embodiments of the invention envisage the pre-dewatering being carried out using a sedimentation centrifuge, the sedimentation centrifuge being either a solid-bowl screw-type centrifuge or a disc centrifuge as these centrifuges can perform the dewatering of the soot water at a pressure of up to 5 bar and a temperature of up to 150°C.

[0012] In further embodiments of the invention the soot sludge, which is rich in heavy metals, is post-dewatered to a solids content of up to 20%. This is carried out using either continuously operated dewatering equipment, such as a belt filter press, or batchwise-operated dewatering equipment, such as a chamber filter press. The post-dewatering can also be carried out in a drying unit or a spray dryer. After pre-dewatering, the soot sludge can, of course, also be further dewatered in a multi-hearth furnace and subsequently incinerated.

Claims

1. Process for the continuous treatment of soot water that arises from the partial oxidation of heavy-metal-containing liquid hydrocarbons, the soot water being drawn off from the gasification process at a temperature of 150°C to 300°C and a pressure of 40 to 85 bar,

   characterised in that

   the soot water passes through a pressure-reducing device to reduce the pressure to down to approximately 5 bar before it is centrifuged to a solids content of up to 10% (volume%) at a pressure of up to 5 bar and a temperature of up to 150°C in a pre-dewatering step with no agents being added, a pasty soot sludge rich in heavy metals being obtained and a centrate that is low in heavy metal content, the centrate then being recycled, at least in part, to the gasification process as process water.

2. Process according to claim 1, **characterised in that** the soot water is cooled to 150°C by a cooler if the temperature of the soot water is above 150°C.

3. Process according to claim 1, **characterised in that** the process water to be recycled is heated to 150°C if the temperature of the centrate is below 150°C.

4. Process according to one of claims 1 to 3, **characterised in that** the pre-dewatering is carried out with the aid of a sedimentation centrifuge.

5. Process according to claim 4, **characterised in that** the sedimentation centrifuge is either a solid-bowl screw-type centrifuge or a disc centrifuge.

6. Process according to one of claims 1 to 5, **characterised in that** the soot sludge, which is rich in heavy metals, is post-dewatered to a solids content of up to 20% (volume%).

7. Process according to claim 6, **characterised in that** the post-dewatering is carried out using continuously operated dewatering equipment.

8. Process according to claim 7, **characterised in that** the continuously operated dewatering equipment is a belt filter press.

9. Process according to claim 6, **characterised in that** the post-dewatering is carried out using batchwise-operated dewatering equipment.

10. Process according to claim 9, **characterised in that** the batchwise-operated dewatering equipment is a chamber filter press.

11. Process according to claim 6, **characterised in that** the post-dewatering is carried out in a drying unit.

12. Process according to claim 6, **characterised in that** the post-dewatering is carried out in a spray dryer.

13. Process according to claim 6, **characterised in that** the post-dewatering is carried out in a multi-hearth furnace with subsequent incineration taking place.

CLAIMS

1. Process for the continuous treatment of soot water that arises from the partial oxidation of heavy-metal-containing liquid hydrocarbons, the soot water being drawn off from the gasification process at a temperature of 150°C to 300°C and a pressure of 40 to 85 bar,

   wherein the soot water passes through a pressure-reducing device to reduce the pressure to down to approximately 5 bar before it is centrifuged to a solids content of up to 10% at a pressure of up to 5 bar and a temperature of up to 150°C in a pre-dewatering step with no agents being added, a pasty soot sludge rich in heavy metals being obtained and a centrate that is low in heavy metals accumulating, the centrate then being recycled, at least in part, to the gasification process as process water.

2. Process according to claim 1, wherein the soot water is cooled to 150°C by a cooler if the temperature of the soot water is above 150°C.

3. Process according to claim 1, wherein the process water to be recycled is heated to 150°C if the temperature of the centrate is below 150°C.

4. Process according to any one of claims 1 to 3, wherein the pre-dewatering is carried out with the aid of a sedimentation centrifuge.

5. Process according to claim 4, wherein the sedimentation centrifuge is either a solid-bowl screw-type centrifuge or a disc centrifuge.

6. Process according to any one of claims 1 to 5, wherein the soot sludge, which is rich in heavy metals, is post-dewatered to a solids content of up to 20%.

7. Process according to claim 6, wherein the post-dewatering is carried out using continuously operated dewatering equipment.

8. Process according to claim 7, wherein the continuously operated dewatering equipment is a belt filter press.

9. Process according to claim 6, wherein the post-dewatering is carried out using batchwise-operated dewatering equipment.

10. Process according to claim 9, wherein the batchwise-operated dewatering equipment is a chamber filter press.

11. Process according to claim 6, wherein the post-dewatering is carried out in a drying unit.

12. Process according to claim 6, wherein the post-dewatering is carried out in a spray dryer.

13. Process according to claim 6, wherein the post-dewatering is carried out in a multi-hearth furnace with subsequent incineration taking place.