hydroconversion catalyst may cause reduced hydrocarbon conversion and require more frequent catalyst change-outs and/or regenerations. Accordingly, various pre-treatment methods, including pre-sulfiding and/or preconditioning, are used to mitigate the effects of thermal shock on a hydroconversion catalyst.

[0005] The benefits of catalyst presulfiding in general are well known in the prior art. For example, the use of high boiling oils, such as vacuum gas oils, and hydrocarbon solvents to aid the incorporation of elemental sulfur into a catalyst is disclosed in U.S. Patent No. 4,943,547. U.S. Patent No. 4,530,917 discloses a method of presulfurizing a hydrotreating catalyst with organic polysulfides.

[0006] U.S. Patent No. 4,177,136 discloses a method of catalyst presulfurizing wherein a catalyst is treated with elemental sulfur. Hydrogen is then used as a reducing agent to convert the elemental sulfur to hydrogen sulfide in situ. U.S. Patent No. 4,089,930 also discloses the pretreatment of a catalyst with elemental sulfur in the presence of hydrogen. U.S. Patent No. 6,291,391 discloses a process for pre-sulfiding using a hydrogen-sulfide containing gas and subsequently pre-conditioning the catalyst with a liquid hydrocarbon conditioning oil.

[0007] U.S. Patent No. 4,443,330 discloses a process for maintaining activity of a catalyst during use in coal liquid upgrading process. An added sulfur-containing liquid is added to the reactor to stabilize and maintain the sulfur level in the reactor.

[0008] Each of the aforementioned processes for presulfiding a hydroconversion catalyst requires one or more of use of added noxious and/or toxic sulfur-containing compounds, equipment for the storage, feeding, and/or separation of said sulfur-containing compounds or elemental sulfur, additional hydrocarbons and/or solvents used during the pre-sulfiding of the catalyst, and other components or chemicals that add to the capital and operating expenses associated with hydroconversion processes.

[0009] Accordingly, there exists a need for efficient and compatible methods of pre-treating a hydroconversion catalyst.

SUMMARY OF THE DISCLOSURE

[0010] E~~In one aspect, e~~mbodiments disclosed herein relate to a hydroconversion process, including: feeding hydrogen and a residuum hydrocarbon comprising sulfur-containing hydrocarbons to an ebullated-bed hydroconversion reactor; contacting the

hydrogen and the residuum hydrocarbon with a pre-conditioned and at least partially sulfided hydroconversion catalyst for converting at least a portion of the residuum hydrocarbon into at least one of a hydrotreated product and a hydrocracked product; and intermittently or continuously: feeding a hydroconversion catalyst comprising a metal oxide to a pre-reactor; feeding hydrogen and the residuum hydrocarbon comprising sulfur-containing compounds to the pre-reactor; contacting the hydroconversion catalyst with the hydrogen and the sulfur-containing compounds in the pre-reactor at conditions of temperature and pressure to concurrently: i) convert at least a portion of the metal oxide to a metal sulfide; and ii) pre-condition the catalyst; recovering a residuum hydrocarbon having a reduced sulfur content from the pre-reactor; and transporting the pre-conditioned and at least partially sulfided hydroconversion catalyst from the pre-reactor to the ebullated-bed hydroconversion reactor.

[0010a] In one aspect, there is provided a hydroconversion process, comprising:

feeding hydrogen and a residuum hydrocarbon comprising sulfur-containing hydrocarbons to an ebullated-bed hydroconversion reactor;

contacting the hydrogen and the residuum hydrocarbon with a pre-conditioned and at least partially sulfided hydroconversion catalyst for converting at least a portion of the residuum hydrocarbon into at least one of a hydrotreated product and a hydrocracked product; and

intermittently or continuously:

feeding a hydroconversion catalyst comprising a metal oxide to a pre-reactor;

feeding hydrogen and the residuum hydrocarbon comprising sulfur-containing compounds to the pre-reactor;

contacting the hydroconversion catalyst with the hydrogen and the sulfur-containing compounds in the pre-reactor at conditions of temperature in the range from about 230°C to about 450°C and pressure in the range from about 1 bar absolute to about 200 bar absolute to concurrently:

i) convert at least a portion of the metal oxide to a metal sulfide; and

ii) pre-condition the catalyst;

recovering a residuum hydrocarbon having a reduced sulfur content from the pre-reactor; and

transporting the pre-conditioned and at least partially sulfided hydroconversion catalyst from the pre-reactor to the ebullated-bed hydroconversion reactor.

[0011] Other ~~aspects~~embodiments and advantages will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0012] Figure 1 is a simplified process flow diagram of hydroconversion processes according to embodiments disclosed herein including the concurrent pre-sulfiding and pre-conditioning of the hydroconversion catalysts.

[0013] Figure 2 is a simplified process flow diagram of hydroconversion processes according to embodiments disclosed herein including the concurrent pre-sulfiding and pre-conditioning of the hydroconversion catalysts.

[0014] Figure 3 is a simplified process flow diagram of hydroconversion processes according to embodiments disclosed herein including the concurrent pre-sulfiding and pre-conditioning of the hydroconversion catalysts.

DETAILED DESCRIPTION

[0015] In one aspect, embodiments disclosed herein relate generally to hydroconversion processes. In other aspects, embodiments disclosed herein relate to concurrent pre-sulfiding and pre-conditioning of hydroconversion catalysts for use in hydroconversion processes.