PROCESS FOR RECOVERING ALKALI METALS AND SULFUR FROM ALKALI METAL SULFIDES AND POLYSULFIDES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 61/781,557, filed March 14, 2013, which is incorporated by reference. ~~This application is a continuation-in-part of U.S. Application No. 12/576,977, filed October 9, 2009, which claims the benefit of U.S. Provisional Patent Application No. 61/103,973, filed October 9, 2008.~~

GOVERNMENT LICENSE RIGHTS

[0002] This invention was made with government support under Award No. DE-FE0000408 awarded by the United States Department of Energy. The government has certain rights in the invention.

FIELD OF THE INVENTION

[0003] The present invention relates to a process for removing nitrogen, sulfur, and heavy metals from sulfur-, nitrogen-, and metal-bearing shale oil, bitumen, heavy oil, or refinery streams. More particularly, the invention relates to a method of regenerating alkali metals from sulfides (mono- and polysulfides) of those metals. The invention further relates to the removal and recovery of sulfur from alkali metal sulfides and polysulfides.

BACKGROUND OF THE INVENTION

[0004] The demand for energy and the hydrocarbons from which that energy is derived is continually rising. The hydrocarbon raw materials used to provide this energy, however, contain difficult to remove sulfur and metals that hinder their usage. Sulfur can cause air pollution, and can poison catalysts designed to remove hydrocarbons and nitrogen oxide from motor vehicle exhaust. Similarly, other metals contained in the hydrocarbon stream can poison catalysts typically utilized for removal of sulfur through standard and improved hydro-desulfurization processes whereby hydrogen reacts under extreme conditions to break down the sulfur bearing organo-sulfur molecules.

[0005] Extensive reserves of shale oil exist in the U.S. that will increasingly play a role in meeting U.S. energy needs. Over 1 trillion barrels reserves lay in a relatively small area known as the Green River Formation located in Colorado, Utah, and Wyoming. As the price of crude oil rises, the resource becomes more attractive but technical issues remain to be