preferred between 350 °C to 500 °C, reaction pressures between 0.1 to 23 MPa, preferred between 0.1 to 10 MPa, reaction time between 0 to 6 h, preferred between 0.5 to 4 h, and water-to-plastic feed weight ratio (only for HTP) between 0:1 to 2:1, preferred between 0:1 to 0.5:1.

The separation process includes multi-stage condensation or distillation. The separator for the separation process includes condensers and distillation columns. The conditions for the separation process include 75 °C to 200 °C for separating gasoline from diesel, 200 °C to 350 °C for separating diesel from heavy oil, and appropriate temperatures between 20 °C to 500 °C for separating other products.

The separation products include gasoline, diesel, light hydrocarbon gases, and other products, which may include jet fuels, waxes, naphtha, lubricants, heavy oils, chemical feedstocks (toluene, xylene, styrene, and other hydrocarbon chemicals) and the like. Light hydrocarbon gases that are recovered may be collected and combusted for energizing the ITCS to render it self-sustaining and/or can be used as products as well.

In one aspect, the present disclosure relates to an integrated thermal conversion and separation system comprising: a reactor vessel having an inlet and an outlet; a filter for preventing solids from passing through the outlet; a first condenser connected in fluidic communication with the reactor vessel for condensing oil; a first separation vessel connected in fluidic communication with the first condenser for separating the oil into at least a gasoline fraction and a diesel fraction; a second condenser connected in fluidic communication with the first separation vessel for receiving and further condensing the diesel fraction into diesel oil; a third condenser connected in fluidic communication with the first separation vessel for receiving and further condensing the gasoline fraction; a second separation vessel connected in fluidic

communication with the third condenser for receiving condensed gasoline fraction and separating the gasoline fraction into vapor and gasoline; a vapor collection vessel connected in fluidic communication with the second separation vessel; a gasoline separation tank connected in fluidic communication with the second separation vessel for collecting gasoline; a chilled water source operationally connected to the respective condensers; a water source operationally connected to the reactor vessel; and a furnace connected in thermal communication with the reactor vessel.

In another aspect, the present disclosure relates to a method of producing useful fuel fluids from solid plastic waste, comprising: loading solid plastic waste matter into a reaction chamber to define a load; subjecting the load to HTP to extract hydrocarbon mixtures; filtering the hydrocarbon mixtures to extract solid matter; separating the hydrocarbon mixtures into a light fraction (C1 to C25) and a heavy fraction (C26 to C31); directing the heavy fraction to a first container and the light fraction to a second container; separating the light fraction into diesel (C8-C25), gasoline (C4-C12), and vapor (C1-C5); directing the diesel to a third container; directing the gasoline to a fourth container; directing the vapor to a fifth container; wherein the hydrocarbon mixtures have a carbon number distribution between C1 and C31; wherein the pressure in the reaction chamber is between 0.1 and 23 MPa; wherein the plastic waste is selected from the group consisting of PS, PE, PP, and mixtures thereof wherein the temperature in the reaction chamber is between 200 and 600 degrees Celsius.