Claims

1. A method for upgrading polymer waste-based material, the method comprising:

providing a polymer waste-based feedstock (step A),

providing a crude oil-derived feedstock (step B),

mixing the polymer waste-based feedstock, the crude oil-derived feedstock, and optionally a further feed material, to provide a feed mixture (step C),

hydrotreating the feed mixture in a FCC feed hydrotreater under FCC feed hydrotreating conditions to provide a hydrocarbonaceous material (step D),

recovering at least a distillate product and a distillation bottoms product from the hydrocarbonaceous material (step E), and

subjecting at least part of the distillation bottoms product to fluid catalytic cracking (FCC), optionally together with a co-feed (FCC co-feed), or to steam cracking.

2. The method according to claim 1, wherein the crude oil-derived feedstock comprises at least one crude oil fraction selected from a vacuum gas oil (VGO) fraction, a gas oil (GO) fraction, a heavy gas oil (HGO) fraction, a kerosene fraction, a light gas oil fraction, an atmospheric residue (AR) fraction, a vacuum residue (VR fraction), and a deasphalted oil (DAO) fraction.

3. The method according to claim 1 or 2, wherein the distillation bottoms product recovered in step E has a 10% boiling point (according to ASTM-D2887) of at least 300°C, preferably at least 310°C, at least 320°C, at least 330°C, at least 340°C, at least 345°C, at least 350°C, or at least 355°C.

4. The method according to any one of the preceding claims, wherein the yield of a heavy fraction boiling at 350°C or above obtained in step D is at least 50 wt.-%, when calculated as the ratio (m_H/m_{liq}) between mass of obtained heavy fraction (m_H) and total mass of liquid hydrocarbonaceous products (m_{liq}), preferably at least 55 wt.-%, at least 60 wt.-%, or at least 65 wt.-%.

5. The method according to any one of the preceding claims, wherein the yield of a light hydrocarbonaceous fraction boiling at 150°C or below obtained in step D is at most 10.0 wt.-%, when calculated as the ratio (m_L/m_{ht}) between mass of obtained light fraction (m_L) and total mass of hydrocarbonaceous products (m_{ht}), preferably at most 8.0 wt.-%, at most 6.0 wt.-%, at most 5.0 wt.-%, at most 4.0 wt.-%, at most 3.0 wt.-%, or at most 2.0 wt.-%.

6. The method according to any one of the preceding claims, wherein the FCC feed hydrotreater operates at a temperature in the range of from 300-460°C.

7. The method according to any one of the preceding claims, wherein the FCC feed hydrotreater operates at a hydrogen partial pressure of at least 10 bar, preferably at least 20 bar, at least 25 bar, at least 30 bar, at least 33 bar, at least 35 bar, at least 38 bar, or at least 40 bar, and/or

wherein the FCC feed hydrotreater operates at a hydrogen partial pressure of at most 100 bar, preferably at most 90 bar, at most 80 bar, at most 70 bar, at most 60 bar, at most 55 bar, or at most 50 bar.

8. The method according to any one of the preceding claims, wherein the FCC feed hydrotreater employs a catalyst and the catalyst is a supported catalyst, and the catalyst preferably comprises at least one component selected from IUPAC group 6, 8 or 10 of the Periodic Table of Elements.

9. The method according to any one of the preceding claims, wherein the FCC feed hydrotreater employs a catalyst and the catalyst is a supported catalyst containing Mo and at least one further transition metal on a support, such as a supported NiMo catalyst or a supported CoMo catalyst, wherein the support preferably comprises alumina and/or silica.

10. The method according to any one of the preceding claims, wherein the FCC feed hydrotreater employs a catalyst and the catalyst is a supported CoMo catalyst and the support comprises alumina ($CoMo/Al_2O_3$) and/or the catalyst is a supported NiMo catalyst and the support comprises alumina ($NiMo/Al_2O_3$).

11. The method according to any one of the preceding claims, wherein the FCC feed hydrotreater works under olefin-saturation conditions.

12. The method according to any one of the preceding claims, wherein the polymer waste-based feedstock provided in step A is a fraction of liquefied polymer waste.

13. The method according to any one of the preceding claims, wherein the feed mixture contains at most 50 wt.-% of the polymer waste-based feedstock, preferably at most 40 wt.-%, at most 30 wt.-% or at most 25 wt.-%, and/or the feed mixture contains at least 0.5 wt.-% of the polymer waste-based feedstock, preferably at least 1.0 wt.-%, at least 1.5 wt.-% or at least 2.0 wt.-%.

14. The method according to any one of the preceding claims, wherein the feed mixture contains at least 25 wt.-% of the crude oil-derived feedstock, preferably at least 30 wt.-%, at least 40 wt.-% , at least 50 wt.-% , at least 60 wt.-% , at least 70 wt.-% or at least 75 wt.-%.

15. The method according to any one of the preceding claims, wherein the polymer waste-based feedstock is a pyrolysis oil feedstock derived from waste plastics (waste plastics pyrolysis oil; WPPO) and/or from end-life tires (end-life tires pyrolysis oil; ELTPO), or a fraction thereof, and/or a feedstock derived from hydrothermal liquefaction of waste plastics and/or of end-life tires, or a fraction thereof.

16. The method according to any one of the preceding claims, wherein the step A of providing the polymer waste-based feedstock includes a step of thermal degradation (such as pyrolysis or hydrothermal liquefaction) of polymer waste.

17. A mixture of hydrocarbons obtainable by the method according to any one of the preceding claims.

18. A hydrocarbonaceous material obtainable in step D of the method according to any one of claims 1 to 16, wherein the hydrocarbonaceous material preferably comprises more than 16 wt.-% of a fraction boiling in the range of 150-300°C and at least 60 wt.-% of a fraction boiling above 370°C.

19. A use of the mixture of hydrocarbons according to claim 17 or of a hydrocarbonaceous material according to claim 18 as a raw material in the production of fuel, chemicals and/or polymers, such as polypropylene and/or polyethylene.