CLAIMS

What is claimed:

1. A system for flexible production of gasoline and jet fuel, the system comprising:

an alkylation reaction zone comprising one or more reactors for reacting C4 olefins, C5 olefins, C6 olefins, C4-C5 olefins, or C4-C6 olefins with C4-C6 isoparaffins in the presence of sulfuric acid alkylation catalyst to produce a hydrocarbon effluent and a spent acid stream;

a flow line for providing C4 olefins to the alkylation reaction zone;

a flow line for providing C5 olefins to the alkylation reaction zone;

a flow line for providing fresh acid alkylation catalyst to the alkylation reaction zone;

a deisobutanizer for separating the hydrocarbon effluent into an isobutane fraction, a n-butane fraction, and a C5+ fraction;

a deisopentanizer for separating the C5+ fraction into an isopentane fraction and a C6+ fraction;

a splitter for separating the C6+ fraction into a light alkylate overhead fraction and a heavy alkylate bottoms fraction;

a flow system for recycling the isobutane fraction to the alkylation reaction zone, recovering the isobutane fraction as an isobutane product, and both recycling a portion of the isobutane fraction to the alkylation reaction zone and recovering a portion of the isobutane fraction as an isobutane product;

a flow system for recycling the isopentane fraction to the alkylation reaction zone, recovering the isopentane fraction as an isopentane product, and both recycling a portion of the isopentane fraction to the alkylation reaction zone and recovering a portion of the isopentane fraction as an isopentane product;

a flow system for recycling the light alkylate fraction to the alkylation reaction zone, recovering the light alkylate as a light alkylate product, and both recycling a portion of the light alkylate fraction to the alkylation reaction zone and recovering a portion of the light alkylate fraction as a light alkylate product; and

a control system configured to adjust the operation of the deisopentanizer, the splitter, and the flow systems to selectively operate the system in one of a gasoline production mode, a jet fuel production mode, and a co-production mode, whereby

the control system is configured to selectively increase or decrease a ratio of gasoline to jet fuel range hydrocarbons produced in the alkylation reaction zone,

wherein when controlling the system to selectively operate in the gasoline production mode the control system is configured to place the deisopentanizer and splitter offline and adjust the flow systems to recycle the isobutane fraction to the alkylation reaction zone;

wherein when controlling the system to selectively operate in the jet fuel production mode the control system is configured to adjust the flow systems to recover the isobutane fraction as an isobutane product and to recycle the isopentane fraction to the alkylation reaction zone; and

wherein when controlling the system to selectively operate in the co-production mode the control system is configured to adjust the flow systems to recycle the isobutane fraction and the isopentane fraction to the alkylation reaction zone.

2. The system of claim 1, further comprising a flow line for providing C6 olefins to the alkylation reaction zone.
3. The system of claim 1 or claim 2, wherein the control system is further configured to adjust a flow rate of each of the C4 olefins, C5 olefins, and the light alkylate recycle fraction to the alkylation reaction zone to selectively increase or decrease a ratio of gasoline to jet fuel range hydrocarbons produced in the alkylation reaction zone.
4. The system of claim 1, wherein the control system is further configured to adjust a reaction temperature of the one or more reactors in the alkylation reaction zone to increase or decrease a ratio of gasoline to jet fuel range hydrocarbons produced in the alkylation reaction zone.
5. The system of claim 1 or claim 4, wherein the control system is further configured to adjust a flow rate of fresh acid catalyst to the one or more reactors in the alkylation reaction zone to increase or decrease a ratio of gasoline to jet fuel range hydrocarbons produced in the alkylation reaction zone.
6. The system of any one of claims 1-5, wherein the control system is further configured to adjust operating conditions in the one or more reactors in the alkylation reaction zone to increase or decrease a ratio of gasoline to jet fuel range hydrocarbons produced in the alkylation reaction zone, wherein the operating conditions are selected from one or more of acid strength, temperature, space velocity, mixing intensity, recycle isobutane to olefin ratio and recycle isopentane to olefin ratio.

7. The system of any one of claim 1-6, further comprising a flow line for recovering the C5+ fraction as a gasoline product fraction.

8. The system of claim 1, wherein the alkylation reaction zone comprises a C4 alkylation reactor and a C5 alkylation reactor;

wherein when controlling the system to selectively operate in the gasoline production mode the control system is configured to place the deisopentanizer and splitter offline and adjust the flow systems to recycle the isobutane fraction to the C4 alkylation reactor;

wherein when controlling the system to selectively operate in the jet fuel production mode the control system is configured to adjust the flow systems to recover the isobutane fraction as an isobutane product and to recycle the isopentane fraction to both the C4 alkylation reactor and the C5 alkylation reactor; and

wherein when controlling the system to selectively operate in the co-production mode the control system is configured to adjust the flow systems to recycle the isobutane fraction to the C4 alkylation reactor and to recycle the isopentane fraction to the C5 alkylation reactor.

9. A process for flexible production of gasoline and jet fuel, including operating the process in a gasoline production mode, a jet fuel production mode, and a co-production mode, the process comprising:

feeding isobutane and butenes to a C4 alkylation reactor for reacting the isobutane and butenes in the presence of sulfuric acid alkylation catalyst to produce a first alkylation effluent and a spent acid stream;

feeding isopentane and pentenes to a C5 alkylation reactor for reacting the isopentane and the pentenes in the presence of sulfuric acid alkylation catalyst to produce a second alkylation effluent and a second spent acid stream;

separating the first and second alkylation effluents in a separation system comprising a deisobutanizer, a deisopentanizer, and an alkylate splitter, the separating comprising:

(i) when operating in the gasoline production mode:

feeding the first and second alkylation effluents to the deisobutanizer;

separating the first and second alkylation effluents into an isobutane fraction, a n-butane fraction, and a C5+ fraction;

recycling the isobutane fraction to both of the C4 alkylation reactor and the C5 alkylation reactor; and

bypassing the deisopentanizer and the alkylate splitter and recovering the C5+ fraction as a gasoline product;

(ii) when operating in the jet fuel production mode:

separating the first and second alkylation effluents in the debutanizer to recover an isobutane fraction, a n-butane fraction, and a C5+ fraction;

separating the C5+ fraction in the deisopentanizer to recover an isopentane fraction and a C6+ fraction;

separating the C6+ fraction in the splitter into a light fraction and a heavy fraction;

feeding the isopentane fraction to both of the C4 and C5 alkylation reactors;

(iii) when operating in the co-production mode:

separating the first and second alkylation effluents in the debutanizer to recover an isobutane fraction, a n-butane fraction, and a C5+ fraction;

separating the C5+ fraction in the deisopentanizer to recover an isopentane fraction and a C6+ fraction;

separating the C6+ fraction in the splitter into a light fraction and a heavy fraction;

feeding the isobutane fraction to the C4 alkylation reactor; and

feeding the isopentane fraction to the C5 alkylation reactor.

10. The process of claim 9, further comprising:

maintaining the sulfuric acid alkylation catalyst in the C4 alkylation reactor at a concentration range titrating as 87 to 95 wt% sulfuric acid / water mixtures, and

maintaining the sulfuric acid alkylation catalyst in the C5 alkylation reactor at a concentration range titrating as 80 to 95 wt% sulfuric acid / water mixtures.

11. The process of claim 9, wherein operating in the jet fuel mode further comprises recycling the light fraction to the C4 and C5 alkylation reactors.

12. The process of claim 9, wherein operating in the jet fuel mode further comprises separating the light fraction to recover an isohexane-containing fraction and feeding

the isohexane-containing fraction to one or both of the C4 alkylation reactor and the C5 alkylation reactor.

13. The process of claim 9, further comprising:

operating the C4 and C5 alkylation reactors at a higher temperature during jet fuel mode than during gasoline production mode; and

operating the C4 and C5 alkylation reactors at a lower acid strength during jet fuel mode than during gasoline production mode.