CLAIMS:

1. A vehicular propulsion system comprising:

an internal combustion engine comprising a combustion chamber; and

a fuel system comprising:

a separation unit comprising at least one adsorbent-based chamber to selectively receive and separate at least a portion of an onboard fuel into an adsorbate as one of an octane-rich fuel component or a cetane-rich fuel component and a remainder as the other of the cetane-rich fuel component and the octane-rich fuel component;

a product tank for selectively receiving and containing the remainder;

a fuel supply tank comprising:

a first compartment for containing the onboard fuel;

a second compartment disposed within the first compartment and configured to selectively receive a vaporized form of the adsorbate from the separation unit such that at least a portion of the vaporized form of the adsorbate that is present in the second compartment is condensed by an exchange of heat with the onboard fuel that is present in the first compartment; and

a third compartment disposed within the second compartment such that both fluid and heat exchange communication is established between them in order to have the third compartment receive at least a portion of any remaining vaporized adsorbate from the second compartment for at least one of storage and additional condensing; and

fuel conduit configured to deliver at least one of the onboard fuel, the octane-rich fuel component and the cetane-rich fuel component to the combustion chamber from at least one of the separation unit, fuel supply tank and product tank.

2. The system of claim 1, further comprising:

a plurality of sensors that are configured to acquire at least one operational parameter associated with the engine and the fuel system; and

a controller cooperative with the engine, sensors and fuel system and configured to determine an operational condition that is selected from a plurality of operational conditions the engine, and to adjust delivery of at least one of the onboard fuel, the octane-rich fuel component and the cetane-rich fuel component to the combustion chamber depending on such operational condition;

wherein the plurality of operational conditions which the engine can operate under comprise a first operational condition and a second operational condition such that when the controller determines that the engine is in the first operational condition, the controller is configured to direct the flow of a portion of the onboard fuel to the combustion chamber without first passing through the separation unit, and when the controller determines that the engine is in the second operational condition, the controller is configured to direct the flow of at least a portion of the onboard fuel to the separation unit, and

wherein the first operational condition of the engine corresponds to an engine temperature that is indicative of at least one of a cold start condition and a warm-up condition, and further wherein the second mode of operation of the engine corresponds to an engine temperature that exceeds the cold start and warm-up engine temperatures.

3. The system of claim 1, further comprising:

a plurality of sensors that are configured to acquire at least one operational parameter associated with the engine and the fuel system; and

a controller cooperative with the engine, sensors and fuel system and configured to determine an operational condition that is selected from a plurality of operational conditions the engine, and to adjust delivery of at least one of the onboard fuel, the octane-rich fuel component and the cetane-rich fuel component to the combustion chamber depending on such operational condition;

wherein the plurality of operational conditions which the engine can operate under comprise a first operational condition and a second operational condition such that when the controller determines that the engine is in the first operational condition, the controller is configured to direct the flow of a portion of the onboard fuel to the combustion chamber without first passing through the separation unit, and when the controller determines that the engine is in the second operational condition, the controller is configured to direct the flow of at least a portion of the onboard fuel to the separation unit, and

wherein the first operational condition of the engine corresponds to at least one of the product tank and the fuel supply tank containing an amount of cetane-rich fuel component or octane-rich fuel component that is below a threshold level, and further wherein the second mode of operation of the engine corresponds to an engine temperature that exceeds a cold start and warm-up engine temperatures.

4. The system of claim 1, wherein the first and second compartments are concentrically arranged relative to one another, wherein the third compartment comprises a bundle of tubes that define a flowpath that extends along a substantially elongate dimension of the second compartment and wherein the second and third compartments are concentrically arranged relative to one another.

5. The system of claim 1, wherein the first and second compartments are concentrically arranged relative to one another and wherein a supply of onboard fuel is disposed within a volumetric space defined by a housing that defines the first compartment and a housing that defines the second compartment.

6. The system of claim 1, further comprising a regenerator disposed within the separation unit and configured to deliver at least a portion of excess heat that is generated by the operation of the engine to the at least one adsorbent-based chamber that has the adsorbate disposed thereon.

7. The system of claim 1, further comprising a temperature regulator configured to maintain the temperature of an onboard fuel contained within the first compartment to within a design temperature range.

8. The system of claim 1, wherein the at least one adsorbent-based chamber comprises a plurality of stages such that a first stage preferentially adsorbs octane-rich compounds using an affinity-based adsorbent while the second stage preferentially adsorbs cetane-rich compounds using a size-selective adsorbent.

9. A vehicular fuel system for converting an onboard fuel into octane-rich and cetane-rich components, the fuel system comprising:

a separation unit comprising at least one adsorbent-based chamber to selectively receive and separate at least a portion of an onboard fuel into an adsorbate as one of an octane-rich fuel component or a cetane-rich fuel component and a remainder as the other of the cetane-rich fuel component and the octane-rich fuel component;

a product tank for selectively receiving and containing the remainder;

a fuel supply tank comprising:

a first compartment for containing the onboard fuel;

a second compartment disposed within the first compartment and configured to selectively receive a vaporized form of the adsorbate from the separation unit such that at least a portion of the vaporized form of the adsorbate that is present in the second compartment is condensed by an exchange of heat with the onboard fuel that is present in the first compartment; and

a third compartment disposed within the second compartment such that both fluid and heat exchange communication is established between them in order to have the third compartment receive at least a portion of any remaining vaporized adsorbate from the second compartment for at least one of storage and additional condensing; and

fuel conduit configured to deliver at least one of the onboard fuel, the octane-rich fuel component and the cetane-rich fuel component to the combustion chamber from at least one of the separation unit, fuel supply tank and product tank.

10. A method of operating an internal combustion engine, the method comprising:

configuring a fuel system to comprise a fuel supply tank with an onboard fuel being disposed in a first compartment of the fuel supply tank, a separation unit and a product tank cooperative with one another through fuel conduit and responsive to directions provided by a controller;

using the controller to ascertain an operational condition of the engine;

using the controller to direct the flow of a portion of the onboard fuel to a combustion chamber of the engine without first passing through the separation unit when the engine is in a first operational condition;

using the controller to direct the flow of a portion of the onboard fuel to the separation unit when the engine is in a second operational condition such that an adsorbate in the form of one of an octane-rich fuel component and a cetane-rich fuel component collects on a surface of at least one chamber of the separation unit, while a remainder of the portion of the onboard fuel is directed to product tank for storage as the other of the cetane-rich fuel component and the octane-rich fuel component; and

when using the controller to direct the flow of a portion of the onboard fuel to the separation unit:

conveying a vaporized form of the adsorbate from the separation unit to a second compartment that is disposed within the first compartment of the fuel supply tank;

condensing at least a portion of the vaporized by an exchange of heat with the onboard fuel that is present in the first compartment;

conveying at least a portion of any remaining vaporized adsorbate from the second compartment to a third compartment that is disposed within the second compartment such that at least one of storage and additional condensing takes place in the third compartment; and

conveying at least one of the cetane-rich fuel component and the octane-rich fuel component to the combustion chamber.

11. A vehicular propulsion system comprising:

an internal combustion engine comprising a combustion chamber; and

a fuel system configured to provide fuel to the combustion chamber, the fuel system comprising:

a fuel supply tank configured to contain an onboard supply of fuel, the fuel supply tank comprising a heat exchanger comprising at least a first compartment for containing the onboard fuel and a second compartment disposed within the first compartment;

a separation unit in fluid communication with the fuel supply tank and comprising at least one adsorbent-based chamber to selectively receive and separate at least a portion of the onboard supply of fuel into a plurality of components comprising either (a) an octane-rich adsorbate and a cetane-rich remainder or (b) a cetane-rich adsorbate and an octane-rich remainder; and

a product tank in fluid communication with the separation unit for selectively receiving and containing the remainder, wherein

the fuel supply tank and separation unit are thermally and fluidly cooperative with one another such that a desorbate produced by a regenerative operation of the separation unit upon the octane-rich or cetane-rich adsorbate is received by the second compartment in order to have at least a portion of excess heat that has been imparted to the desorbate through the regenerative operation removed by an onboard supply of fuel contained within the first compartment.

12. The vehicular propulsion system of claim 11, wherein the first and second compartments are configured such that the onboard supply of fuel that is present in the first compartment and the desorbate that is present in the second compartment are in fluid communication with one another solely through the separation unit.

13. A method of providing fuel to an internal combustion engine, the method comprising:

configuring a fuel system to comprise a fuel supply tank with an onboard fuel being disposed in a first compartment of the fuel supply tank, a separation unit and a product tank cooperative with one another through fuel conduit and responsive to directions provided by a controller;

using the controller to ascertain an operational condition of the internal combustion engine; and

using the controller to either direct the flow of a portion of the onboard fuel to either (a) a combustion chamber of the internal combustion engine without first passing through the separation unit when the engine is in a first operational condition or (b) the separation unit when the engine is in a second operational condition such that an adsorbate in the form of one of an octane-rich fuel component and a cetane-rich fuel component collects on a surface of at least one chamber of the separation unit, while a remainder of the portion of the onboard fuel is directed to product tank for storage as the other of the cetane-rich fuel component and the octane-rich fuel component, wherein using the controller to direct the flow of a portion of the onboard fuel to the separation unit comprises:

having the separation unit perform a regenerative operation to create a desorbate from at least a portion of the octane-rich or cetane-rich adsorbate;

having the desorbate be conveyed from the separation unit to a second compartment that is disposed within the first compartment of the fuel supply tank;

having at least a portion of the desorbate within the second compartment be condensed by an exchange of heat with the onboard fuel that is present in the first compartment; and

conveying at least one of (a) the desorbate that is present in the second compartment and (b) the remainder that is in the product tank to the combustion chamber.

14 The method of claim 13, wherein using the controller to direct the flow of a portion of the onboard fuel to the separation unit further comprises conveying the desorbate that is present in the second compartment to a third compartment prior to conveying the desorbate to the combustion chamber, the third compartment configured such that it is fluidly and thermally cooperative with the second compartment such that at least a portion of the desorbate within the second compartment that is conveyed to the third compartment is condensed by an exchange of heat between the second and third compartments.

15. The method of claim 13, wherein using the controller to ascertain an operational condition of the internal combustion engine comprises determining an operational condition of the internal combustion engine based on at least one sensed parameter associated with the operation thereof.

16. A fuel system for an internal combustion engine, the fuel system comprising:

a fuel supply tank configured to contain an onboard supply of fuel, the fuel supply tank comprising a heat exchanger comprising at least a first compartment for containing the onboard fuel and a second compartment disposed within the first compartment;

a separation unit in fluid communication with the fuel supply tank and comprising at least one adsorbent-based chamber to selectively receive and separate at least a portion of the onboard supply of fuel into a plurality of components comprising either (a) an octane-rich adsorbate and a cetane-rich remainder or (b) a cetane-rich adsorbate and an octane-rich remainder;

a product tank in fluid communication with the separation unit for selectively receiving and containing the remainder, wherein

the fuel supply tank and separation unit are thermally and fluidly cooperative with one another such that a desorbate produced by a regenerative operation of the separation unit upon the octane-rich or cetane-rich adsorbate and that is received by the second compartment in order to have at least a portion of excess heat that has been

imparted to the desorbate through the regenerative operation removed by an onboard supply of fuel contained within the first compartment; and

a controller configured to (a) determine an operational condition of an internal combustion engine based on at least one sensed parameter associated with the operation thereof, and (b) adjust delivery of at least one of the onboard fuel, the desorbate and the remainder to a combustion chamber within the internal combustion engine in response to such determined operational condition.