CLAIMS

1. A gas chromatographic method for analyzing natural gas, comprising:

transporting the natural gas through a chiller;

transporting the natural gas from the chiller to at least two gas upgrading membranes each comprising at least three upgraded product stream outlets placed to provide a first cut of upgraded natural gas, a second cut of upgraded natural gas, and a third cut of upgraded natural gas respectively;

operating a gas chromatographic system comprising at least one upstream gas chromatograph and at least two downstream gas chromatographs comprising a first downstream gas chromatograph and a second downstream gas chromatograph, wherein

the at least one upstream gas chromatograph, the first downstream gas chromatograph, and the second downstream gas chromatograph all operate simultaneously,

the at least one upstream gas chromatograph, the first downstream gas chromatograph, and the second downstream gas chromatograph are all calibrated using the same calibration feed, and

the at least one upstream gas chromatograph, the first downstream gas chromatograph, and the second downstream gas chromatograph all utilize the same heating oven to heat samples of natural gas;

transporting samples of natural gas to the gas chromatographic system, wherein

a sample of the natural gas exiting the chiller, a sample of the natural gas entering a first membrane of the at least two gas upgrading membranes, and a sample of the natural gas entering a second membrane of the at least two gas upgrading membranes are transported to the at least one upstream gas chromatograph, and

a sample of the upgraded natural gas exiting each of the upgraded product stream outlets are transported to the at least two downstream gas chromatographs; and

monitoring the composition of the sample of the natural gas exiting the chiller, the sample of the natural gas entering a first membrane of the at least two gas upgrading membranes, the sample of the natural gas entering a second membrane of the at least

two gas upgrading membranes, and the samples of the upgraded natural gas exiting each of the product stream outlets with a controller to determine upgrading of the natural gas.

2. The method of claim 1, wherein the samples of the upgraded natural gas exiting the product stream outlet placed to provide the first cut of upgraded natural gas is transported to the first downstream gas chromatograph.

3. The method of claim 1, wherein the sample of the upgraded natural gas exiting the product stream outlet placed to provide the second cut of upgraded natural gas from the first membrane is transported to the first downstream gas chromatograph and the sample of the upgraded natural gas exiting the product stream outlet placed to provide the second cut of upgraded natural gas from the second membrane is transported to the second downstream gas chromatograph.

4. The method of claim 1, wherein the samples of the upgraded natural gas exiting the product stream outlet placed to provide the third cut of upgraded natural gas is transported to the second downstream gas chromatograph.

5. A gas chromatographic method for analyzing natural gas, comprising:

transporting the natural gas through a chiller;

transporting the natural gas from the chiller to at least two gas upgrading membranes each comprising at least three upgraded product stream outlets placed to provide a first cut of upgraded natural gas, a second cut of upgraded natural gas, and a third cut of upgraded natural gas respectively;

operating a gas chromatographic system comprising at least one upstream gas chromatograph and at least two downstream gas chromatographs comprising a first downstream gas chromatograph and a second downstream gas chromatograph, wherein

the at least one upstream gas chromatograph, the first downstream gas chromatograph, and the second downstream gas chromatograph all operate simultaneously,

the at least one upstream gas chromatograph, the first downstream gas chromatograph, and the second downstream gas chromatograph are all calibrated using the same calibration feed, and

the at least one upstream gas chromatograph, the first downstream gas chromatograph, and the second downstream gas chromatograph all utilize the same heating oven to heat samples of natural gas;

transporting samples of natural gas to the gas chromatographic system, wherein

a sample of the natural gas entering the chiller, a sample of the natural gas entering a first membrane of the at least two gas upgrading membranes, and a sample of the natural gas entering a second membrane of the at least two gas upgrading membranes are transported to the at least one upstream gas chromatograph, and

a sample of the upgraded natural gas exiting each of the upgraded product stream outlets are transported to the at least two downstream gas chromatographs; and

monitoring the composition of the sample of the natural gas entering the chiller, the sample of the natural gas entering a first membrane of the at least two gas upgrading membranes, the sample of the natural gas entering a second membrane of the at least two gas upgrading membranes, and the samples of the upgraded natural gas exiting each of the product stream outlets with a controller to determine upgrading of the natural gas.

6. The method of claim 5, wherein the samples of the upgraded natural gas exiting the product stream outlet placed to provide the first cut of upgraded natural gas is transported to the first downstream gas chromatograph.

7. The method of claim 5, wherein the sample of the upgraded natural gas exiting the product stream outlet placed to provide the second cut of upgraded natural gas from the first membrane is transported to the first downstream gas chromatograph and the sample of the upgraded natural gas exiting the product stream outlet placed to provide the second cut of upgraded natural gas from the second membrane is transported to the second downstream gas chromatograph.

8. The method of claim 5, wherein the samples of the upgraded natural gas exiting the product stream outlet placed to provide the third cut of upgraded natural gas is transported to the second downstream gas chromatograph.

9. A natural gas upgrading system comprising a gas chromatographic system, a chiller, at least two gas upgrading membranes, and a controller, wherein:

the gas chromatographic system comprises at least one upstream gas chromatograph and at least two downstream gas chromatographs comprising a first downstream gas chromatograph and a second downstream gas chromatograph;

the chiller is configured to remove heavy hydrocarbons from a natural gas supply feed and is fluidly connected to the at least two gas upgrading membranes;

the at least two gas upgrading membranes are configured to selectively allow certain gases to permeate to remove impurities from the natural gas and each comprise an inlet and at least three product stream outlets placed to provide a first cut of upgraded natural gas, a second cut of upgraded natural gas, and a third cut of upgraded natural gas respectively;

the at least one upstream gas chromatograph is fluidly connected to the inlet or exit of the chiller, the inlet of a first membrane of the at least two gas upgrading membranes, and the inlet of a second membrane of the at least two gas upgrading membranes for transport of samples to the at least one upstream gas chromatograph;

each of the product stream outlets is fluidly connected to at least one of the at least two downstream gas chromatographs for transport of samples to the at least two downstream gas chromatographs;

the controller is configured to monitor the composition of the samples of the natural gas from the exit of the chiller, the inlet of the first membrane of the at least two gas upgrading membranes, the inlet of the second membrane of the at least two gas upgrading membranes, and the samples from each of the product stream outlets to determine upgrading of the natural gas; and

the at least one upstream gas chromatograph and the at least two downstream gas chromatographs are configured to operate simultaneously, are calibrated by a single calibration gas feed, and a single heating oven or set of heating ovens in series is

provided to heat natural gas samples for the at least one upstream gas chromatograph and the at least two downstream gas chromatographs.

10. The natural gas upgrading system of claim 9, wherein the heavy hydrocarbons are C7 or above.

11. The natural gas upgrading system of claim 9, wherein the product stream outlet placed to provide the first cut of upgraded natural gas of the first membrane and the product stream outlet placed to provide the first cut of upgraded natural gas of the second membrane are fluidly connected to the first downstream gas chromatograph.

12. The natural gas upgrading system of claim 9, wherein the product stream outlet placed to provide the second cut of upgraded natural gas of the first membrane is fluidly connected to the first downstream gas chromatograph and the product stream outlet placed to provide the second cut of upgraded natural gas of the second membrane is fluidly connected to the second downstream gas chromatograph.

13. The natural gas upgrading system of claim 9, wherein the product stream outlet placed to provide the third cut of upgraded natural gas of the first membrane and the product stream outlet placed to provide the third cut of upgraded natural gas of the second membrane are fluidly connected to the second downstream gas chromatograph.

14. The natural gas upgrading system of claim 9, wherein the controller is coupled to a flow regulator configured to controllably adjust the rate at which the natural gas supply feed is provided to the chiller.

15. The natural gas upgrading system of claim 9, wherein the controller is coupled to the chiller to adjust the operating temperature of the chiller.

16. The natural gas upgrading system of claim 9, wherein the controller is coupled to a graphical display configured to provide process operating parameters output by the gas chromatographic system.

17. The natural gas upgrading system of claim 9, wherein the two gas upgrading membranes are configured to selectively remove nitrogen and acid gases from the natural gas supply feed.