CLAIMS

1. A method for cleaning one or more components of a gas turbine engine, comprising:

forming a working fluid having droplets of a detergent entrained in a flow of steam, wherein forming the working fluid includes controlling a size distribution of the droplets of the detergent;

introducing the working fluid into a gas flow path and a cooling circuit defined by the one or more components of the gas turbine engine such that the working fluid impinges upon a surface of the one or more components of the gas turbine engine, wherein the size distribution of the droplets of the detergent includes droplets of the detergent in the working fluid having a range of different sizes, wherein a first portion of the droplets are characterized by a size smaller than 100 microns and is for cleaning the gas flow path of a compressor of the gas turbine engine, a second portion of the droplets are characterized by a size between 100 microns and 500 microns and is for cleaning one or more of the gas flow path of a combustor of the gas turbine engine or one or more internal passages of the cooling circuit of the combustor¸ and wherein the second portion is further for cleaning one or more gas flow path surfaces of a turbine section of the gas turbine engine and one or more internal passages of the cooling circuit of the turbine section; and

changing controlling the size distribution of the droplets based on the one or more components that require cleaning by controlling a steam pressure of the flow of steam in which the droplets of the detergent are entrained;

wherein forming the working fluid includes atomizing the detergent in an atomizing nozzle prior to discharging the working fluid from a fluid delivery mechanism.

2. The method of claim 1, wherein the size distribution of the droplets of the detergent in the working fluid is controlled to be effective to be substantially accommodated in the gas flow path and the cooling circuit.

3. The method of claim 1, wherein at least 50 percent of the droplets of the detergent have a size smaller than 500 microns.

4. The method of claim 1, wherein at least 50 percent of the droplets of the detergent have a size smaller than 100 microns.

5. The method of claim 1, further comprising varying one or more of a detergent flow rate, the steam pressure, or an atomizing nozzle geometry to control the size distribution of the droplets of the detergent in the working fluid.

6. The method of claim 1, wherein forming the working fluid includes is formed during atomizing the detergent using the flow of steam.

7. The method of claim 1, wherein the working fluid is configured to selectively dissolve one or more constituents of foreign material on the surface of the one or more components of the gas turbine engine.

8. The method of claim 1, further comprising heating the detergent before atomizing by contacting the detergent with the flow of steam.

9. The method of claim 1, wherein the detergent has a pH in a range from about 2.5 to about 7.

10. The method of claim 1, wherein the gas flow path is a hot gas path in the gas turbine engine.

11. The method of claim 1, wherein the gas turbine engine is disposed on an aircraft or installed in an industrial application.

12. A method for in-situ cleaning of a gas flow path and a cooling circuit defined by one or more components of a gas turbine, comprising:

forming a working fluid having droplets of a detergent entrained in a flow of steam, wherein forming the working fluid includes controlling a size distribution of the droplets of the detergent; and

introducing the working fluid into the gas flow path and the cooling circuit such that the working fluid is configured to impinge upon a surface of the one or more components of the gas turbine engine,

wherein the size distribution of the droplets of the detergent includes the droplets of the detergent in the working fluid having a range of different sizes, wherein a first portion of the droplets are characterized by a size smaller than 100 microns and is for cleaning the gas flow path of a compressor of the gas turbine engine, a second portion of the droplets are characterized by a size between 100 microns and 500 microns and is for cleaning one or more of the gas flow path of a combustor of the gas turbine engine or one or more internal passages of the cooling circuit of the combustor, and wherein the second portion is further for cleaning one or more gas flow path surfaces of a turbine section of the gas turbine engine and one or more internal passages of the cooling circuit of the turbine section, and

wherein the size distribution of the droplets of the detergent in the working fluid is controlled to be effective to be substantially accommodated in the gas flow path or the cooling circuit by controlling a steam pressure of the flow of steam in which the droplets of the detergent are entrained;

wherein forming the working fluid includes atomizing the detergent in an atomizing nozzle prior to discharging the working fluid from a fluid delivery mechanism.

13. The method of claim 12, wherein at least 50 percent of the droplets of the detergent have a size smaller than 500 microns.

14. The method of claim 13, wherein forming the working fluid includes atomizing the detergent in an atomizing nozzle.

15. The method of claim 14, wherein the working fluid is configured to selectively dissolve one or more constituents of foreign material on the one or more surfaces surface of the one or more components of the gas turbine engine.

16. A method for cleaning one or more components of a gas turbine engine, comprising:

forming a working fluid having droplets of a detergent entrained in a flow of steam, wherein forming the working fluid includes controlling a size distribution of the droplets of the detergent;

introducing the working fluid into a gas flow path and a cooling circuit defined by the one or more components of the gas turbine engine such that the working fluid impinges upon a surface of the one or more components of the gas turbine engine, wherein the size distribution of the droplets of the detergent includes droplets of the detergent in the working fluid having a range of different sizes, wherein a first portion of the droplets are characterized by a size smaller than 100 microns and is for cleaning the gas flow path of a compressor of the gas turbine engine, a second portion of the droplets are characterized by a size between 100 microns and 500 microns and is for cleaning one or more of the gas flow path of a combustor of the gas turbine engine or one or more internal passages of the cooling circuit of the combustor¸ and wherein the second portion is further for cleaning one or more gas flow path surfaces of a turbine section of the gas turbine engine and one or more internal passages of the cooling circuit of the turbine section;

wherein forming the working fluid includes atomizing the detergent in an atomizing nozzle prior to discharging the working fluid from a fluid delivery mechanism.

17. The method of claim 16, wherein forming the working fluid includes atomizing the detergent with the flow of steam.

18. The method of claim 17, further comprising controlling the size distribution of the droplets by controlling one or more of a detergent flow rate, a steam pressure of the flow of steam which the droplets of the detergent are entrained, or a geometry of an atomizing nozzle.

19. The method of claim 18, wherein the size distribution of the droplets of the detergent in the working fluid is controlled to be effective to be substantially accommodated in the gas flow path and the cooling circuit of the gas turbine engine.