CLAIMS

1. A method for cleaning a coke deposit from an internal surface of a process equipment, the method comprising:

propelling a flexible pig comprising a plurality of bristles and a flexible body through the process equipment, wherein the flexible pig is propelled by a fluid comprising an aqueous solution; and

removing at least a portion of the coke deposit from the internal surface using the flexible pig, without damaging a metal protective layer of the internal surface of the process equipment,

wherein the flexible body comprises a molded polymeric body comprising a polymeric material, wherein at least a portion of each of the plurality of bristles extends into and is anchored by the polymeric material;

wherein the molded polymeric body comprises an axial portion and a plurality of radial portions formed in spaced intervals along the axial portion; and

wherein a diameter of the axial portion is less than an outer diameter of each of the plurality of radial portions.

2. The method of claim 1, wherein the step of removing comprises:

placing the flexible pig in the process equipment such that the plurality of bristles of the flexible pig are in contact with the internal surface;

providing a fluid force against an end of the flexible pig; and

contacting the coke deposit with at least one of the plurality of bristles.

3. The method of claim 1, further comprising:

after the step of removing, performing intelligent pigging to determine a condition of the internal surface of the process equipment; and

reapplying a protective metal to any portion of the internal surface having less than a threshold thickness of the metal protective layer.

4. The method of claim 1, wherein the metal protective layer protecting the internal surface comprises a stannide.

5. The method of claim 1, wherein the process equipment comprises a furnace tube.

6. The method of claim 1, wherein the flexible pig has a metal protective layer on at least one of the plurality of bristles.

7. The method of claim 6, further comprising:

transferring at least a portion of the metal protective layer on the at least one of the plurality of bristles onto the internal surface of the process equipment, wherein the metal protective layer on the at least one of the bristles comprises a stannide.

8. The method of claim 1, wherein the at least a portion of each of the plurality of bristles is partially encapsulated by the polymeric material of the flexible body.

9. The method of claim 8, wherein at least one of the plurality of bristles comprises a metal protective layer containing stannide.

10. The method of claim 1, wherein each of the plurality of bristles are in the axial portion, one of the plurality of radial portions, or a combination of the axial portion and the one of the plurality of radial portions.

11. The method of claim 1, wherein the plurality of bristles are polymer bristles, steel bristles, natural bristles or any combination of polymer bristles, steel bristles, or natural bristles.

12. The method of claim 2,

wherein a fluid source provides the fluid force of less than about 60 psig to the end of the flexible pig causing at least one of the plurality of bristles of the flexible pig to contact the coke deposit.

13. A method for cleaning a coke deposit from an internal surface of a process equipment, the method comprising:

aromatizing hydrocarbons in an aromatization reactor system to produce an aromatization product, wherein the aromatization reactor system comprises a furnace having a plurality of furnace tubes disposed therein, wherein the internal surface of each of the plurality of furnace tubes has a metal protective layer comprising stannide disposed thereon, and wherein coke deposits are formed on the metal protective layer of the internal surface of one or more of the plurality of furnace tubes;

halting the aromatizing;

propelling a flexible pig comprising a plurality of bristles and a flexible body through the process equipment, wherein the flexible pig is propelled by a fluid comprising an aqueous

solution, wherein the flexible body comprises a molded polymeric body comprising a polymeric material, wherein at least a portion of each of the plurality of bristles extends into and is anchored by the polymeric material, wherein the molded polymeric body comprises an axial portion and a plurality of radial portions formed in spaced intervals along the axial portion, and wherein a diameter of the axial portion is less than an outer diameter of each of the plurality of radial portions;

removing at least a portion of the coke deposit from the internal surface using the flexible pig, without damaging the metal protective layer of the internal surface of the furnace tubes;

optionally inspecting one or more of the plurality of furnace tubes via video inspection or ultrasonic gauging; and

resuming aromatization of hydrocarbons in the aromatization reactor system.

14. The method of claim 1, wherein the fluid further comprises one or more additives selected from a surfactant, a rheology modifier, an emulsifier, an anti-foaming agent, ammonia, or combinations thereof.

15. The method of claim 1, wherein the fluid is supplied by a fluid source.

16. The method of claim 1, wherein the plurality of bristles do not scrape the internal surface of the process equipment.

17. The method of claim 1, wherein the flexible pig is propelled by a fluid force of less than about 60 psig.

18. The method of claim 13, wherein the step of removing comprises:

placing the flexible pig in the process equipment such that the plurality of bristles of the flexible pig are in contact with the internal surface;

providing a fluid force against an end of the flexible pig; and

contacting the coke deposit with at least one of the plurality of bristles.

19. The method of claim 13, further comprising:

reapplying a protective metal to any portion of the internal surface having less than a threshold thickness of the metal protective layer.

20. The method of claim 13, wherein each of the plurality of bristles is in the axial portion, one of the plurality of radial portions, or a combination of the axial portion and the one of the plurality of radial portions.

21. The method of claim 13, wherein the at least a portion of each of the plurality of bristles is partially encapsulated by the polymeric material of the flexible body.