CLAIMS

1. A scraper assembly configured to traverse an exterior surface of a tubular member, the scraper assembly comprising:

a casing constructed and arranged to drive the scraper assembly to traverse the exterior surface of the tubular member; and

a primary ring fixed to the casing, having a plurality of projections formed of a semi-rigid material extending inward toward the exterior surface of the tubular member, the plurality of projections having a length selected to define:

an inner diameter of the primary ring less than an outer diameter of the tubular member when the plurality of projections are in an extended configuration, and

a contact angle formed between the plurality of projections and the exterior surface of the tubular member of between about 15° and about 75° when the plurality of projections are in an inclined configuration.

2. The scraper assembly of claim 1, further comprising a supplemental ring fixed to the casing having a plurality of projections circumferentially offset from the primary ring.

3. The scraper assembly of claim 2, further comprising a spacer fixed to the casing positioned between the primary ring and the supplemental ring.

4. The scraper assembly of claim 1, further comprising a flexible ring fixed to the casing having an inner diameter less than the outer diameter of the tubular member.

5. The scraper assembly of claim 1, configured to traverse the exterior surface of a plurality of tubular members arranged in parallel, the scraper assembly comprising an array of primary rings, each primary ring from the array of primary rings positioned to traverse the exterior surface of a corresponding tubular member.

6. The scraper assembly of claim 1, wherein the semi-rigid material has a yield strength of between about 215 MPa and 290 MPa and a tensile strength of between about 505 MPa and 620 MPa.

7. The scraper assembly of claim 6, wherein the length of the plurality of projections are selected to define the contact angle based on the yield strength and the tensile strength of the semi-rigid material.

8. The scraper assembly of claim 6, wherein the plurality of projections each have a thickness of between about 0.1 mm and about 2.0 mm, selected based on the yield strength and the tensile strength of the semi-rigid material.

9. The scraper assembly of claim 1, wherein each of the plurality of projections makes up an arc length of the primary ring of between about 4° and about 30°.

10. The scraper assembly of claim 1, wherein an interior surface of the plurality of projections has a smaller radius of curvature than a corresponding outer diameter of the primary ring.

11. A water treatment system comprising:

a vessel having an inlet and an outlet;

at least one light source assembly positioned within the vessel, comprising an ultraviolet light housed in a quartz sleeve;

a scraper assembly configured to traverse an exterior surface of the at least one light source assembly, the scraper assembly comprising:

a casing constructed and arranged to drive the scraper assembly to traverse the exterior surface of the at least one light source assembly; and

at least one ring fixed to the casing, each ring positioned to traverse the exterior surface of a corresponding light source assembly, each ring having a plurality of projections formed of a semi-rigid material extending inward toward the exterior surface

of the corresponding light source assembly, the plurality of projections having a length selected to define:

an inner diameter of the ring less than an outer diameter of the tubular member when the plurality of projections are in an extended configuration, and

a contact angle formed between the plurality of projections and the exterior surface of the corresponding light source assembly of between about 15° and about 75° when the plurality of projections are in an inclined configuration.

12. The system of claim 11, further comprising an ultraviolet light sensor positioned to monitor ultraviolet light intensity through the water treatment system.

13. The system of claim 12, further comprising a controller operatively connected to the ultraviolet light sensor and the scraper assembly, configured to operate the scraper assembly to traverse the exterior surface of the at least one light source assembly responsive to the monitored ultraviolet light intensity being below a threshold value.

14. The system of claim 11, further comprising a controller operatively connected to the scraper assembly, configured to operate the scraper assembly to traverse the exterior surface of the at least one light source assembly responsive to manual actuation or periodically on a pre-determined schedule.

15. The system of claim 11, wherein the semi-rigid material is selected to be substantially inert to the quartz sleeve and components of the water to be treated.

16. The system of claim 11, further comprising a source of a chemical cleaner fluidly connected to the vessel.

17. A method of retrofitting a water treatment system including at least one light source assembly including an ultraviolet light housed in a quartz sleeve, the method comprising:

providing a scraper assembly configured to traverse an exterior surface of the at least one light source assembly, the scraper assembly comprising:

a casing constructed and arranged to drive the scraper assembly to traverse the exterior surface of the at least one light source assembly; and

at least one ring fixed to the casing, each ring positioned to traverse the exterior surface of a corresponding light source assembly, each ring having a plurality of projections formed of a semi-rigid material extending inward toward the exterior surface of the corresponding light source assembly, the plurality of projections having a length selected to define:

an inner diameter of the ring less than an outer diameter of the tubular member when the plurality of projections are in an extended configuration, and

a contact angle formed between the plurality of projections and the exterior surface of the corresponding light source assembly of between about 15° and about 75° when the plurality of projections are in an inclined configuration; and

providing instructions to install the scraper assembly by the casing to drive the scraper assembly to traverse the exterior surface of the at least one light source assembly.

18. The method of claim 17, wherein the water treatment system includes a track constructed and arranged to guide the scraper assembly by the casing to traverse the exterior surface of the at least one light source assembly, the method further comprising providing the scraper assembly compatible with the track.

19. The method of claim 17, further comprising providing instructions to install a track to guide the scraper assembly by the casing to traverse the exterior surface of the at least one light source assembly.

20. A method of removing organic material fouling from an exterior surface of a quartz sleeve positioned within a water treatment system comprising an ultraviolet light housed in the quartz sleeve and a scraper assembly configured to traverse the exterior surface the quartz sleeve, the scraper assembly comprising a casing constructed and arranged to drive the scraper assembly to traverse the exterior surface of the quartz sleeve and a ring fixed to the casing having a

plurality of projections formed of a semi-rigid material extending inward toward the exterior surface of the quartz sleeve, the method comprising:

directing the scraper assembly to traverse the exterior surface of the quartz sleeve in a first direction to scrape at least 80% of the organic material fouling from the exterior surface of the quartz sleeve.

21. The method of claim 20, comprising periodically directing the scraper assembly to traverse the exterior surface of the quartz sleeve on a pre-determined schedule.

22. The method of claim 21, wherein the pre-determined schedule is every twelve hours or longer.

23. The method of claim 20, further comprising monitoring ultraviolet light intensity through the water treatment system and directing the scraper assembly to traverse the exterior surface of the quartz sleeve responsive to the ultraviolet light intensity being below a threshold value.

24. The method of claim 20, further comprising applying a chemical cleaning process before or concurrently while directing the scraper assembly to traverse the exterior surface of the quartz sleeve.

25. The method of claim 20, wherein the organic material fouling comprises one or more of hardened deposits, sedimentation, oil, grease, and microbiological fouling.

26. The method of claim 25, wherein an amount and/or composition of the organic material fouling is not substantially removable with a rubber scraper.

27. The method of claim 20, comprising operating the water treatment system substantially continuously for at least about six months before replacing the scraper assembly or the ring.