Critique of the Materials of Construction for Rotating Biological Contactors (RBC)

In the last few years some RBC replacement projects have specified the use of Stainless Steel (S.S.) or polymeric materials or Hot Dip Galvanized steed (HDG) for various parts of the RBC structure. The equipment vendors offering these specifications have made claims of improved corrosion resistance with the use of these materials. Other claims of superiority have also been made.

As a manufacturer of an RBC design proven from almost 40 years of use, Walker Process Equipment (WPE) believes our Customers are being misled by these claims. In particular, the advantages for a specification of S.S., polymeric or HDG have been overstated and are potentially misleading to the Owner. Unfortunately, WPE believes the specification for S.S. or other materials are being advertised not for reasons that bring added value to the Customer, but for the sole purpose of eliminating from competition other vendors who chose not to offer these materials for the reasons commented upon below. Please consider the following points when evaluating the materials of construction of your RBC.

What Are the Options Offered for Materials of Construction?

Here are the major structural components of an RBC, the material options being offered from actual project specifications issued for recent projects and comments about the choices:

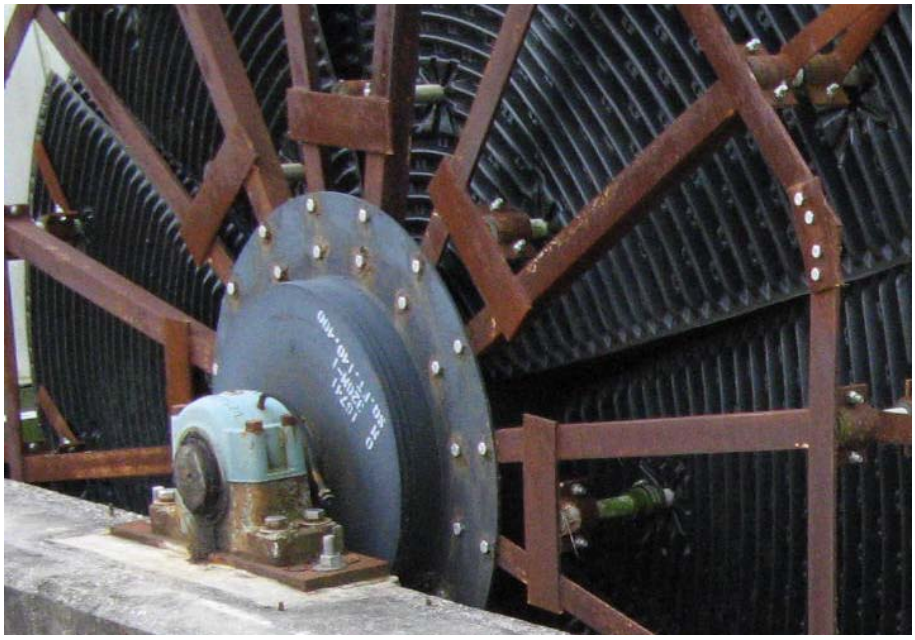
RBC Structural Member	Material of Construction			
	WPE EnviroDisc	Alternate Specification 'A'	Alternate Specification 'B'	Alternate Specification 'C'
Main Shaft	Carbon steel API5L pipe, coated with coal tar epoxy	Carbon steel API 5L pipe, coated with coal tar epoxy	ASTM A36 carbon steel Pipe, coated with epoxy	API 5L Grade B pipe, coated with epoxy
Bearing Stub End or Stub Shafts	AISI 4140 heat treated alloy steel, coated with coal tar epoxy	AISI 4140 heat treated alloy steel, coated with coal tar epoxy	high strength steel, coated with epoxy	AISI 1045 steel, coated with epoxy
Main Shaft End Plates or Torque Collars	ASTM A-36 coated with coal tar epoxy	ASTM A-36 coated with coal tar epoxy	commercial quality steel, coated with epoxy	commercial quality steel, coated with epoxy
Media Support Structure	Formed steel arms, coated with coal tar epoxy	304 Stainless, sand blast and coal tar epoxy finish	304L Stainless, including nuts, bolts, washers etc.	316SS or HDG
Media Support Rods	Carbon steel Pipe, coated with coal tar epoxy	304 Stainless, sand blast and coal tar epoxy finish	316 stainless	316 SS or FRP rod

A. Main Shaft: Consider that no successful RBC manufacturer we know of currently offers, or has ever offered a Main Shaft or associated shaft components in any material of construction other than that shown above.

Why are these critical parts not offered in for example, S.S.? Since these members are exposed to the same environment as other structural members, and if S.S. offers advantages for some parts in an RBC, why is it not preferred for these critical items?

We believe that the issues of unresolved structural strength, lack of proven service life and high cost are the reasons no one recommends changing the materials of construction for these critical parts. Over 40 years of successful use of the materials cited above, which all credible RBC vendors specify for these critical parts provides overwhelming evidence of their suitability. Please bear this important point in mind when offered the choices that follow.

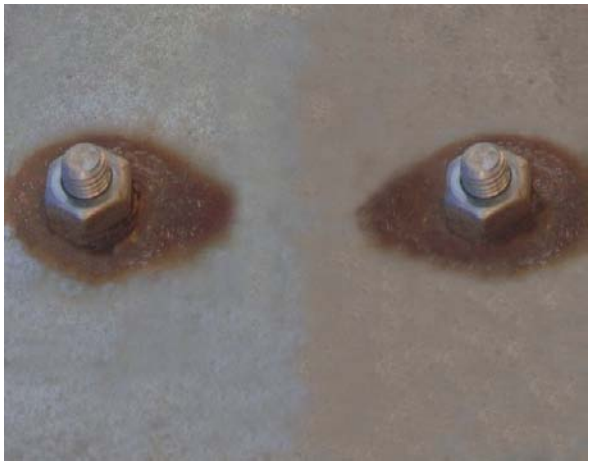
B. Corrosion Resistance: We all recognize that no RBC Media Support System should age and corrode like this.



Frankly, none of the specifications above should result in this condition. But there are some subtle corrosion resistance issues that all the above Alternate Specifications have that compare unfavorably to epoxy coated carbon steel construction.

-Hot Dipped Galvanized (HDG): The combination of HDG, secured with stainless steel fasteners allows the potential for Galvanic Corrosion. Here is an RBC installation in this specification:

This shows the result of galvanic corrosion in a non-RBC installation of HDG with S.S. fasteners



Reference: http://commons.wikimedia.org/wiki/File:Galvanic_corrosion-1b.jpg

Once this corrosion begins, the protective layer of HDG is compromised and the mild steel under the HDG coating will continue to corrode.

- Stainless Steel: It is an interesting fact that S.S. is in fact, more susceptible to several types of corrosion than often thought. Some of the corrosion susceptibilities are cosmetic problems and some are of structural concern.

- Iron contamination: All welds on S.S. structures are prone to rust from iron contamination forming heat tint or darkening/discoloration of the weld areas. These areas can initiate small crevices which can grow into strength reducing cracks.

- It is the thin oxide layer of S.S. which provides its corrosion barrier. Scratches, wear spots or other physical damage to that thin oxide area will expose the metal with no oxide protection and allow corrosion.

- Chlorine Stress Corrosion Cracking (CLSCC): The cyclical type stresses imposed on RBC structural components, the presence of Chlorides from either Coastal installation sea waters or occasional Chloride RBC Cleaning can shorten the life of S.S. components.

- Microbial Influenced Corrosion(MIC): There are about a dozen bacteria known to cause MIC of carbon steels, stainless steels, aluminum alloys and copper alloys in waters and soils with pH 4-9 and temperature 10 C – 50 C. Recently more attention is being given to this little understood mechanism, especially in an industry based on microbiology as ours is. While quantitative negative effects of this mechanism are difficult to judge, a common treatment to offset this corrosion is to coat the metal surfaces i.e. paint. Perhaps this is why the Alternate Specification A includes a coal tar epoxy coating on the 304 S.S. Media Support components.

C. Maintenance Costs:

We understand that a benefit being advertised for the Alternate Specification materials is that the Customer never needs to re-coat the components to maintain the carbon steel protection. Consider these counterpoints to that position.

- WPE has never heard of an RBC built to our specifications shown in this critique, to ever require shutdown and repainting of the coal tar epoxy coating.

- Should any of the corrosion effects noted above compromise the corrosion protection of a HDG or S.S. item, an equipment shutdown and surface repair to those areas would be required to maintain a 20-year service life. Requirements like this would mean a significantly higher life-of-product maintenance cost for these alternate material choices.

D. Structural Comparison:

One of the Alternate Specifications above state that a design using S.S. or HDG media support components must have been in successful service for 5 years.

WPE believes that Customers investing in an RBC expect a 20 year useful life. These alternate materials do not have that proven service life.

The ultimate tensile strength and rigidity for the structural shapes used in Media Support structures in carbon steel is greater than the alternate materials specified. The strength of S.S. nuts and bolts is less than the high-strength bolts in the WPE specification. There is certainly no structural advantage to the Alternate Specification materials, there may prove to be disadvantages and long service life from them is doubtful.

E. Final Thought

Our industry is primarily governed by Public Bidding requirements, whose objectives include:

- Secure the lowest cost goods and services which meet the needs
- Base purchasing decisions on reasonably unrestricted competition between providers of equivalent goods and services

WPE finds no technical evidence to favor the Alternate Specifications from the recent projects cited in this critique and finds potential disadvantages to all of them. We can only conclude that the construction of those Specifications is mainly based on restricting competition in order for the potential vendor to secure a contract. WPE believes that strategy neither fulfills the intent of competitive public bidding nor serves the long term best interest of the customer.

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