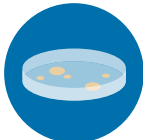


	Method	Pros	Cons
BULK WATER METHODS	 BACTERIA DIP SLIDES Solid bacteria growth media on a plastic paddle is dipped into a water sample, incubated for 24 to 48 hours, and visually examined to estimate total bacteria count in water.	Simple on-site test for monitoring aerobic bacteria counts. Eliminates issues with microbes growing or dying during transport. Trends can provide insight into overall microbial activity.	Semi-quantitative test. Only measure a small fraction of the bacteria growing in water. Results require days and can be difficult to interpret. Does not detect surface attached bacteria and other microorganisms growing in biofilms.
	 LAB PLATE CULTURE COUNTS Water sample is shipped to a laboratory, inoculated on a bacteria growth media, incubated under standard conditions, and analyzed to determine the culturable bacteria count.	Different culture media and incubation conditions can be used to quantify different types of bacteria and other micro-organisms. Trends can provide insight into overall microbial activity.	Results may not reflect conditions at time of sampling. Only measures a fraction of the bacteria growing in water. Results require days. Does not detect surface attached bacteria and other microorganisms growing in biofilms.
	 ATP Luminometer and test strips used to measure the amount of ATP, the primary carrier of energy in cells, in a water sample. The ATP concentration in a liquid or surface sample can be used as an indicator of microbial activity.	Quick on-site method for quantifying the overall microbial activity in a water sample.	Results subject to several interferences and can be difficult to interpret. Does not correlate with bulk water bacteria counts. Does not detect surface attached bacteria and other microorganisms growing in biofilms.
BIOFILM MONITORING METHODS	 VISUAL Routinely inspect the water clarity, open sumps, tower fill, open heat exchangers, strainers, filters, etc. for signs of biofouling and other microbial control problems.	Simple and quick method. Can be performed with minimal training.	Reactive indicator. Problems only visually apparent after biofouling has become well established. Most surfaces are not accessible for visual observation.
	 OPERATIONAL METRICS Routinely monitor HX approach temperatures, pressure drops across filters and strainers, and other operational data for indications of reduced heat transfer and blockages.	Provides tangible indicator of impact of microbiological control problem on cooling system performance. Most systems include the necessary readouts and gauges.	Reactive indicator. Problems only visually apparent after biofouling has become well established. Issues with equipment performance may not be related to microbiological problems.
	 VERIFYING BIOCIDES FEED Verify routine biocide feeds by tracking actual and expected chemical usage and by monitoring the ORP response during oxidizing biocide feeds.	Verify routine biocide feeds by tracking actual and expected chemical usage and by monitoring the ORP response during oxidizing biocide feeds.	Confirming biocide additions does not measure microbial activity or control. ORP response is impacted by many factors and probes are require routine cleaning and calibration. Probes should be replaced annually.
REAL-TIME MONITORS	 BIODART Continuous, real-time monitor that quantifies the potential to form biofilm. Measures the overall impact of bacteria counts, biocide additions, nutrient load, and operation on biofilm growth and microbiological control.	Predictive indicator. Enables proactive adjustments to keep microbiological growth under control. Provides an quantitative measure of biofilm growth potential rather than confusing bulk water microbiological counts.	Measurements do not indicate whether biofouling will actually occur but rather measure the potential for biofouling under amplified conditions.