"Monitoring Aromatic Organics and Optimizing Coagulation Treatment"

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With the increasing awareness about the negative effects of organics within the water and wastewater treatment process and on the health of those using the water, along with increasingly strict water quality regulations, the need for real time organics monitoring is becoming ever more important.

Aromatic Organics Are a Problem

One of the most problematic types of organics is aromatic organics. The double bond ring structure of aromatic molecules results in free electrons. These free electrons make aromatic organics react readily with other molecules around them, causing aromatic organics to generally be more reactive then other organics. Examples of aromatic organics are humic acids, such as tannins. Non-aromatic (aliphatic) organics include fulvic acids and other types of less reactive organic molecules.

Given the wild nature of aromatic organics, these types of organic compounds more readily combine with disinfectants such as chlorine, creating hazardous disinfection by-products (DBPs) such as trihalomethanes (THMs) and haloaciditic acids (HAAs). As we learn more about these DBPs and their health effects, regulations are following to try and further minimize their formation, therefore increasing the requirements for water treatment plants to remove these aromatic organics.

Additionally, aromatic organics will also combine more easily with other chemicals used for coagulation and absorption within the water and wastewater treatment process affecting their treatment performance.

Therefore, monitoring of aromatic organics is a very important aspect of any water or wastewater treatment plant operation.

UV 254nm Best Detector of Aromatic Organics

Aromatic organics are best detected using the UV 254nm wavelength, because of the strong absorption properties that these double bond organics have at the UV 254nm wavelength. Therefore, the greater the absorption of UV light at the UV 254nm wavelength the higher amount of aromatic organics and vice versa.

Other organic test parameters, such as Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), have their own slightly different biases. For example, DOC focuses on the dissolved organics as well as some non-organic carbons, where as the 5 day BOD test focuses on the biologically active organics. UV 254nm is the only one of these organic test parameters which has the bias towards the problematic aromatic organics.

There is now reliable field and online UV 254nm organic testing instrumentation available, allowing for the monitoring of aromatic organics to be even easier.

Turbidity Only Provides Half the Water Quality Story, Not an Organic Test Parameter

Turbidity testing is an important water quality parameter, however it only tells half the water quality story.

Turbidity testing measures scattered visible light which results from various types of matter in the water, mostly providing an indication of the amount of larger particles. UV 254nm measures the amount of UV light absorbed or transmitted through the water, providing an indication of the amount of natural organic matter (NOM) in the water.

Although turbidity is not an organic test parameter, since it has long been used as a measure of general water quality it is commonly being used instead of performing an actual measure of organic content. This could also be due to the fact that until the more recent use of the UV 254nm organic test parameter, organic testing has not been easily attainable given the expense, time and complexity of measuring the organic test parameters in the past. Therefore turbidity testing used to be the only real option.

This reliance upon turbidity tests alone without analysis of organics can result in the ineffective optimization of a wide range of treatment methods. Problems that occur include inadequate chemical dosing of coagulants and disinfectants, poor filter performance optimization, increased DBP formation and more.

Further understanding of the water quality from simply performing UV 254nm organic testing can greatly improve these treatment processes and their finished drinking water or wastewater quality.

UV 254nm Compared to Color

Another water quality parameter that is sometimes used as a surrogate to measuring organics is color. Since humic acids can sometimes give a visible color to the water, the visible light used to test color can give an indication of some organics. However, color is a far inferior method to performing a UV 254nm test and generally it is not recognized as an accurate organic test parameter.

As with turbidity, it is possible to have a water supply which has a low amount of color without having corresponding low amounts of organics. The UV 254nm organic test parameter is a superior parameter to rely upon for indication of organics.

Optimization of Coagulation/Flocculation Best Achieved with UV 254nm Monitoring

Aromatic organics will consume coagulants increasing coagulant demand. Since turbidity can not determine organic load, it is essential that the UV 254nm test parameter be used to provide the operator with valuable information about the amount of aromatic organics in the water or wastewater, and the ability of the coagulant to remove these organics.

Turbidity can remain the same even though organic levels are increasing or decreasing. Therefore, if a sudden increase in organics occurs, by monitoring UV 254nm on the raw water, even though turbidity is remaining the same, the operator will know that they have to increase the coagulant dosage. This also works for a sudden decrease in organics. Turbidity stays the same and the coagulant dosage can likely be lowered.

By monitoring the treated water/wastewater for UV 254nm the operator can ensure that they did not over or under adjust the coagulant dose. Monitoring of UV 254nm is essential for ensuring optimum coagulant dosing.

Additionally, even if turbidity goals have already been met with a certain amount of coagulant, by monitoring UV 254nm, the operator can determine if the addition of more coagulants would further improve the removal of aromatic organics. This can provide tremendous benefits for any plant.

The following diagram demonstrates the importance of testing UV 254nm to determine optimal coagulant dosing for effective removal of both particulate and aromatic organics. In this case, it is clear that turbidity testing alone would not provide the operator with the appropriate water quality data on which to base the optimal coagulant dose, which is shown by UV 254nm testing.

It is important to note that often, the turbidity results from the jar tests do not represent the actual turbidity results that would be seen from using the coagulant in the plant. This discrepancy between jar test turbidity and actual plant turbidity is due to several different factors, such as ambient temperature and floc reuse. This stresses yet another importance of testing UV 254nm.

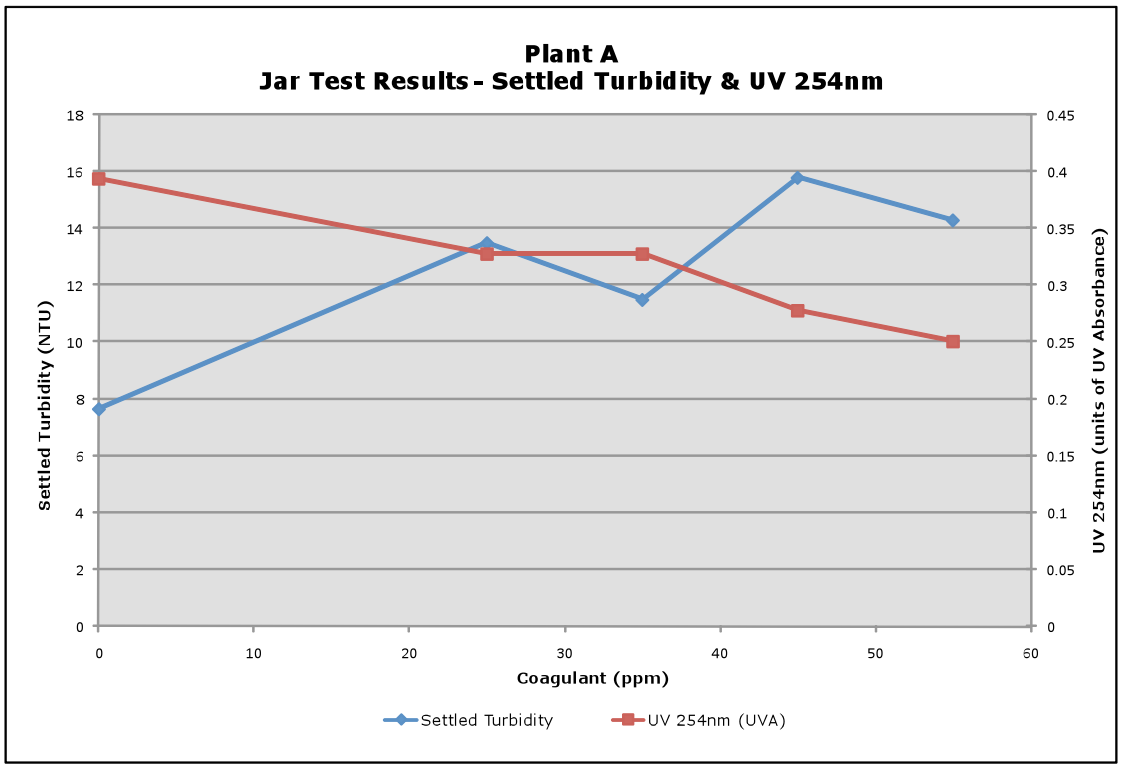

Diagram 1: Plant Jar Test Results – Settled Turbidity & UV 254nm

The Role of SUVA

Another water quality parameter that is becoming increasingly referenced especially for coagulation applications, is Specific UV Absorbance (SUVA). SUVA is simply UV 254nm divided by the DOC of a water sample. This allows the aromatic biased UV 254nm measurement to be normalized over the overall organic load in the water. A characterization of the aromaticity of the water independent from the general level of organics in the water can then be obtained.

$$SUVA = \frac{UV\ 254nm\ (m^{-1})}{DOC\ (mg/L)}$$

In general, it is accepted that if the SUVA of the raw water is greater than 2, then UV 254nm will be the best way to determine coagulation dosing. Otherwise, if the SUVA is less than 2, then the turbidity of the water will likely play a role in coagulation dosing since the level of aromatic organics is relatively low. It should be noted that in general, most surface waters contain significant amounts of aromatic organics and therefore have SUVA values of greater than 2, making UV 254nm clearly the parameter of choice for most coagulation dosing applications.

Real Time UV 254nm Organic Monitoring Provides Optimum Coagulation Performance

To further the benefit of UV 254nm organic monitoring for coagulation applications, online UV 254nm organic testing instrumentation can be installed before and after the coagulation process. This allows for the real time monitoring of changes to both the raw water organic load and treated water organics, providing immediate determination, control and optimization of the coagulation treatment process.

The online UV 254nm testing instrumentation can also be arranged so that the chemical feed of the coagulant is automatically controlled by real time measurements providing instantaneous adjustment and therefore optimal performance of the coagulants.

Added Benefits of Monitoring Percent Removal of Organics

There is now also an online UV 254nm testing monitor on the market that can provide an affordable dual feed option, which enables one online UV 254nm testing monitor to be used for two sample water feeds.

For coagulation applications, by using an online UV 254nm testing monitor with dual feed option the raw and treated water can be measured to provide percent removal of organics by the coagulation treatment process. The plants goals for effectiveness of the coagulation process, whether it be 40% removal of organics or 60% removal of organics, can continuously be monitored providing a real time understanding of the effectiveness of their coagulation treatment process and ensuring their organic removal goals are being met at all times.

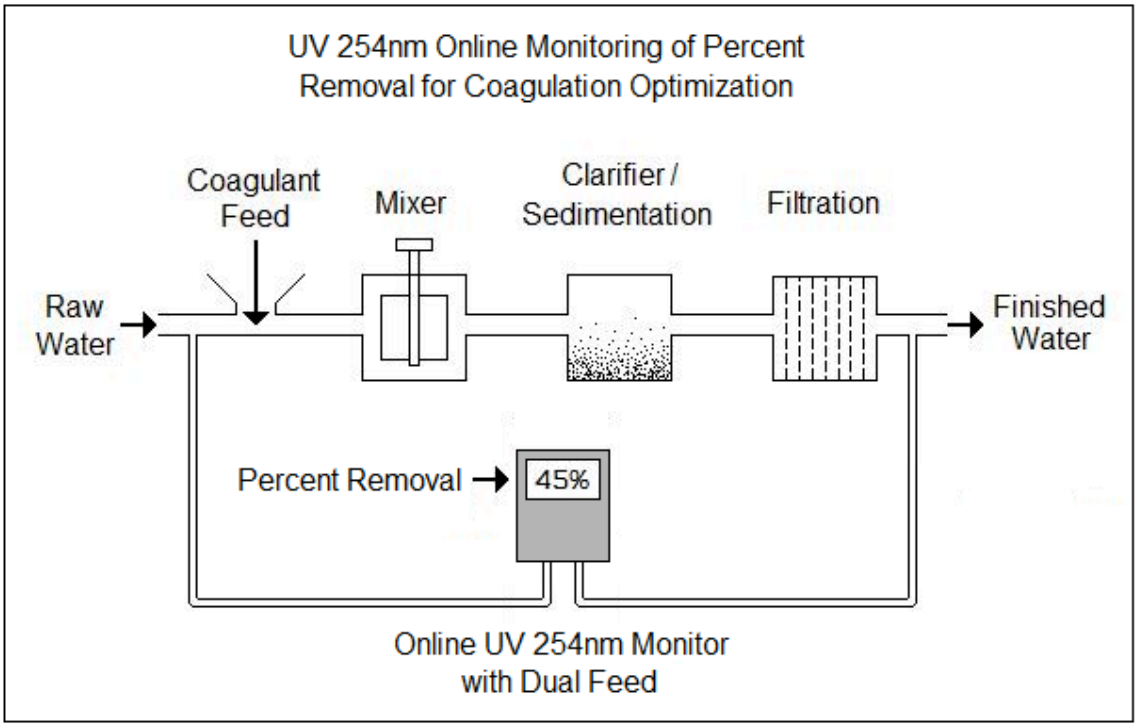

Diagram 2: Real Time UV 254nm Monitoring Ensures Coagulation Optimization

UV 254nm Monitoring of Aromatic Organics Invaluable for Any Plant

As we increase our understanding about the negative effects that aromatic organics have throughout the entire water/wastewater treatment plant, the UV 254nm test parameter is truly enabling the water industry to be able to meet our shared common goal to ever improve our water quality.

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