Bar Theory No. 1: Water Coagulation

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The conventional drinking water treatment process consists of coagulation, sedimentation, filtration, and disinfection. The main objective of these processes is to remove particles including Giardia, Crypto, and other pathogens. The coagulation process consists of rapid mixing and flocculation. Rapid mixing introduces chemicals (coagulants) into process water and destabilizes suspended particles. Flocculation combines small particles into large flocs which can be removed by sedimentation.

First, let us picture the water treatment facility as a bar, and men and women as particles. The objective is to pair all men and women. For many men and women, like particles in water, if there are repelling forces between them, nothing will happen between them. To make them become attractive to each other we can quickly add a proper dose of alcohol, or chemical. If the dosage is not adequate, the repelling charge is not fully neutralized. If the dosage is too high (or drunk), it will result in a reverse charge which generates a new repelling force.

After a rapid addition of a proper dosage of alcohol, men and women are very much attracted to each other. However, if everyone sits still, nothing will happen. A typical example is a formal restaurant which serves alcohol. A slow mixing between men and women is needed for them to encounter. This is why a bar is designed for people to walk around. Like particles in water, not every encounter will produce a result. The efficiency depends on the attractive force which in turn depends on the proper alcohol dosage. Regardless of the efficiency, more mixing means more opportunities. However, an extremely high mixing could break up existing pairs. To get better efficiency, two or three-stage mixing can be used. The first stage should use the fastest mixing and the last one the slowest mixing. A sharp person will walk inside the bar quickly first to identify targets. Then he or she will slow down to focus on a few targets.

Mixing time is also important. If someone stays inside a bar for five minutes, the chance for him or her to pair with someone is very limited. A 30-minute stay will provide more opportunities. A 10-hr stay may produce the most opportunities, but will cost more money. Therefore, mixing time is governed by economic factors as well as particle encounters.

In winter, raw water generally has a low temperature and low turbidity. Winter is the most difficult time to treat water. Why? A low turbidity means a low particle concentration. Much like the bar scenario where a person will have a less chance of meeting others on Monday night than on Friday or Saturday night.

In summary, a successful pairing (floc formation) depends on a rapid addition (rapid mixing) of a proper dosage of alcohol (coagulant), a proper slow mixing (flocculation mixing), adequate mixing time (flocculation time), and a bar full of men and women (a high original particle concentration). The efficiency could be improved by using a two or three-stage slow mixing (flocculation). Most importantly, an overdose of chemical will result in a reversed charge and a repelling force between you and others, not to mention the economic cost.