

Why is it possible that Flint River water cannot be treated to meet Federal Standards?

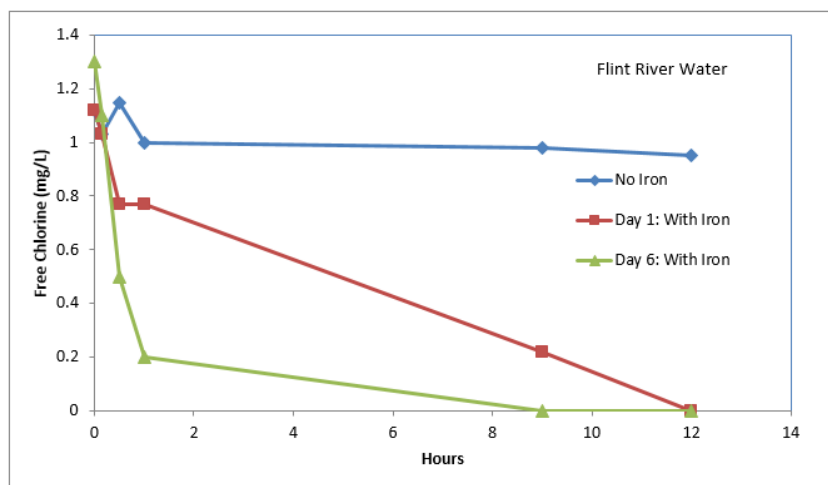
Why is it possible that Flint River water cannot be treated to meet Federal Standards?

The key problem is that water from the Flint River is highly corrosive to iron and lead, and, unfortunately, these pipe materials are widely used throughout Flint. Herein, we discuss the higher corrosivity of Flint River water to iron, and the associated problem maintaining chlorine disinfectant in the system.

Why is Flint River water more corrosive compared to Detroit water? Flint River water has about 8 times more chloride (Cl) in it than Detroit water. Chloride is generally considered to be very corrosive to iron. For instance, chloride present in road salts applied in the winter causes iron in cars and bridges to rust. Detroit also adds a corrosion inhibitor chemical (orthophosphate) to their water that helps to reduce corrosion of metals such as iron and lead. So, current Flint water is not only more corrosive, but there is also no corrosion inhibitor present.

Iron corrosion can cause a serious problem for meeting Federal standards using Flint River Water, because iron corrosion consumes chlorine. Chlorine is added to the water to prevent growth of microorganisms that cause disease, and maintaining a chlorine residual is the best way to protect public health against human pathogens.

To illustrate how iron corrosion is problematic for maintaining a chlorine residual, we collected a sample of Flint water. We put some of that sample into a clean glass container, and some more of it into an identical container with a piece of iron to simulate the effect of water on iron pipes in Flint. We then measured the decay of chlorine over time (Figure 1). The initial level of chlorine was 1.15 milligrams per liter (mg/L), and it stayed pretty high when it was in a glass container. It only dropped to 0.95 mg/L over 12 hours (blue line). Thus, if Flint had a glass (or plastic or concrete) pipe system, chlorine would stay high as it was transported to homes. But when we did the same test with iron present, the chlorine dropped faster due to the corrosion, and was all gone after only 12 hours (red line). After 6 days of doing the test, the chlorine dropped even faster, and was below the minimum required chlorine residual of 0.2 mg/L in just about 1 hour in our test system (green line). **The key point is that Flint River water is corroding iron pipes, and that will cause the chlorine to disappear very quickly.**



When we did the exact same test using water from Detroit (collected on the outskirts of Flint), the chlorine in the container without the iron stayed high at about 0.6 mg/L over a 12 hour test (blue line below). When iron was present, chlorine dropped, but much slower than in the Flint River water (red line and green line). Ironically, Detroit water started with only about 60% of the chlorine initially present in Flint water, but ended up with much more chlorine after 12 hours because there was less iron corrosion. What is more, comparing Day 1 to Day 6, Flint water ate up

more chlorine the longer the test was run, whereas Detroit water ate up less chlorine the longer the test was run.

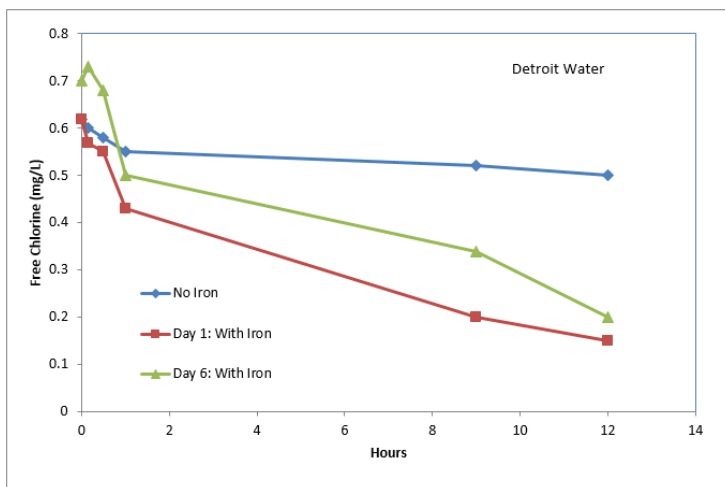


Figure 2: Decaying of free chlorine in Detroit water with and without iron

Figure 3 shows a picture of Flint water and Detroit water after reacting in the glass containers described after the first 5 days of the test. This also illustrates why residents have been complaining of “red” or discolored water after the switch to the Flint River source.



Figure 3: Higher release of iron is evident in the Flint water glass reactor containing iron than that with Detroit water

At present, as a rough estimate which we will elaborate on later, it looks like Detroit water is about 5 times less corrosive to iron pipe than Flint River water. This also probably means that the iron pipes in the city of Flint system will fail 5 times faster using the Flint River water rather than the Detroit water. In fact, this is probably already occurring as evidenced by [increased rates of water main leaks and breaks](#). While an economic analysis cannot yet be done based on our limited

data, it is possible (and even likely) that the economic damage to the Flint pipe system due to corrosion is going to cost the city tens of millions of dollars more in pipe repair costs in the coming years compared to what they would have paid if they had stayed on Detroit water.

Conclusion: The high rates of iron corrosion from using Flint River water as a drinking water source are [damaging the Flint distribution system](#). The corrosion is also causing chlorine to disappear quickly, which may make it more likely for harmful bacteria to grow in the water. Furthermore, it is possible that with the existing unlined iron pipe system in Flint, and the relatively low water demand (due to declining population, loss of GM – which used a lot of water – as a water customer, and high rates), that it will very difficult to meet Federal standards for minimum chlorine levels no matter what is done to treat the water.

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