# Alum Water Treatment for GC Backpackers

There is a great web description of alum treatment for Rafters at this link

http://www.gcrg.org/bqr/7-4/water.htm

This method is based on that page, somewhat simplified. But it is worth reading for background.

The basic theory behind alum treatment is that even clean-looking river water contains fine sediment that will: (1) soon clog a pump-style water filter and/or (2) interfere with the action of chemical-based treatments like iodine or Aqua Mira. Cloudy-looking river water has the same problems, even more so, and is also unpleasant. Alum allows the sediment to gradually clump ("flocculate") fine river sediment into larger particles. The larger (and heavier) particles gradually settle to the bottom, allowing you to take cleaner water carefully from the top. You then treat the water with a chemical or filter it. Flocculation itself does not remove disease-causing organisms. You will still need a filter or a chemical treatment for that purpose.

It is very easy to use too much alum. Excessive alum for the circumstances lowers pH (makes it more acidic). Low pH then interferes with effective flocculation of river sediment since alum will only cause flocculation within the range of 5-8 pH. So too much alum will prevent flocculation since it lowers the pH immediately and causes flocculation slowly if at all. In addition, excessive alum will cause the water to taste bad (like really bad lemonade) and exposes you to chemicals you don't need.

Unfortunately, any given river, including the Colorado, is different on different days and the alum amount that works on one day may not work on another. This is because the pH of the water differs based on which tributaries are active, among other factors. Also, the amount of sediment in the water changes constantly. So some experimentation is necessary.

The best way to start is to make a 1:100 concentration of alum dissolved into already-clean water (e.g., from your prior night). You can do this in the field, but it is better to experiment at home so that you know how to do this, using measurement methods that will work for you in the field.

The 1:100 concentrate has two advantages over just adding dry alum to the bucket directly: (1) you can dissolve the alum thoroughly in the clean water and (2) because of the small quantities involved, the initial dilution of alum makes it easier to adjust the amount that will eventually go into your bucket of river water.

I am assuming you will have two buckets, a water bottle that shows 100 ml markings, some kind of measuring spoon and preferably an irrigation syringe. Our specific components were these, but similar items will work if you know their sizes and adjust appropriately:

For risk of stating the obvious, 1 ml of alum in 100 ml of water makes a 1:100 concentrate. 1 ml (a fluid measure, usually) is the same as 1 cc (usually a dry measure). To have enough to allow for some experimentation in the field, if you want to treat two 10-liter water buckets, you probably want to end up with at least 300 ml of the 1:100 concentrate (30% of a 1-liter water bottle). While precision is probably not needed in the field, the following proportions will work for this purpose

1 US teaspoon is almost 5 ml. Therefore 1 tsp/5ml of alum in 500 ml (1/2 liter or 2+ cups) of clean water will give therefore give you the 1:100 ratio, and enough concentrate to allow at least the start of your experiments, if you are working with two 10-L water buckets.

If you don't usually carry a teaspoon with you, you can measure your usual eating spoon with a syringe or teaspoon before you leave (or on your trip, if you carry an irrigation syringe, as you should). Some syringes are marked with cc's (same as ml's) which makes it easy. Irrigation syringes are often not marked but many are 12 cc's. If you have a water bottle that is marked with cc's, 4 syringe-full's from a 12-cc syringe will raise the level of the water shown by just under 50 cc's, allowing you to confirm the size of the syringe. If you confirm that you have a 12-cc syringe and you can fill up your eating spoon with the 12 cc's, your spoon must hold a little under 2 1/2 tsps. and you could therefore either make about 3/4 liter of the 1:100 concentration with a half spoonful of alum. My smallest spoon field-measured at 4 cc's so we used one spoonful of alum in 400 ml of water for our initial 1:100 concentrate.

Once you have your concentrate, guess at a concentration that you think might just barely work (see guideline below) and add it to river water in one 10-liter bucket. Add twice as much to the other 10-liter bucket. After 45 minutes see which one seems to be best causing a visible flocculent (gradually sinking cloud of white particles). If both concentrations work, and about equally, the next night you might try a concentrate half-way between the two. If the low concentrate works not at all, and the larger one works OK, discard the low-concentrate bucket (the one that isn't flocculating) and re-double the stronger concentration in a replacement bucket. Conversely, if the high-concentrate bucket isn't working and the low-concentrate bucket is working minimally, then dump the high-concentrate bucket and try again with a new bucket with half as much of the 1:100 concentrate as in your prior low-end trials. Repeat these tests until you find a concentration that causes substantial settling within an hour (which will give great settlement overnight).

So where do you start? We found on our last night that that about 50 cc's of the 1:100 concentrate in a 10 L bucket (about 8 L actually in the bucket) worked minimally (slowly) but 100 ccs worked better. We measured the 50 and 100 cc's by squirting in 4 and 8 syringe-fulls of the 1:100 concentrate (using the 12 cc syringe a little over-full) but we probably could have just eyeballed the markings on a water bottle.

The website cited above includes this important additional suggestion:

> Mixing is nearly as important as getting the dosage right. A water treatment plant will normally rapid mix for 30-60 seconds and provide slow, gentle mixing for up to an hour. The rapid mix disperses the treatment chemical so that all the water is treated with no localized overtreatment and the slow mix brings the particles together so that they will grow in size and settle out quicker. In a bucket treatment situation I would recommend at least 15 sec. of rapid mix and 3 minutes of slow mix. The slow mix should be more back and forth across the bucket rather than swirling. Using these techniques it should be possible to produce well clarified water in less than an hour.

Note that the initial mixing of the 1:100 concentrate can be very vigorous (you shake the bottle like mad). We found that sometimes after 30 minutes or so, some of the fine flocculent would gather at the water surface. rather than sinking. A light stir of this top layer seemed to allow this flocculent to re-assemble in larger pieces that sank to the bottle.