What I have Learned about Selenium Toner [KRST]

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March 24, 2000

Selenium toner has always been a problem.

It's expensive. It stinks. It turns murky and dark in storage after it's been used. It stains anything that does more than a few minutes' duty containing it. And Kodak advises us to destroy our shoes if they become contaminated!

I had to start paying attention to my toner after I decided to increase the working-solution concentration. I've been working on a warm-tone fiber base material, and I like the results of selenium toning in KRST diluted 1+5 for ten minutes at about 34C. This is a relatively high concentration, and mixing up three liters, as I like to do, works out to a cost of nearly C$15. This motivates me to make my selenium toner go as far as I possibly can.

In days gone by I mixed KRST at a dilution of 1+15, or even more dilute. I was content to use it for one working session and discard. This was not exactly cheap, but at least it got me out of storage problems.

As has probably become obvious, I am speaking of the Kodak product, which they call 'Kodak Rapid Selenium Toner', or KRST. Selenium toners by other makers are very likely comparable products, although I have not used any.

There are published formulas for selenium toner, so it is possible to prepare it for oneself. However, to do so, powdered selenium must be handled. This substance is both toxic and in an extremely finely divided form. It can very easily become airborne as a fine dust; this makes it very dangerous. Inhalation of any fine powder or dust is to be avoided, especially toxic ones. Anyone who decides to handle selenium powder should have the proper equipment and expertise. The rest of us should just give Mr. Kodak the money for prepackaged selenium toner.

This is probably a good place to deliver the facts about KRST safety. There are serious concerns, and there are also misconceptions about the dangers of this product.

In the liquid form sold as selenium toner, the worst of the toxic components of the mixture are chemically bound. The selenium ingredient is in the form of sodium selenite. Once in solution, this substance does not turn to a gas and leave the solution. This is the source of one of the misconceptions about selenium toner. Since the solution has a powerful odor that strongly attacks human mucous membranes, many people conclude that this is linked to selenium toxicity. But the

selenium cannot travel from the solution to the air and then to the respiratory system; the smell must have another source.

In fact, as many people will recognize, the odor is ammonia, which is a gas. It is present because selenium toner contains ammonium thiosulfate. The safety concerns about ventilation when using selenium toner are the same as for ammonia. It is a serious hazard, but not in the category of airborne selenium dust. Ammonia has been an intimate companion of humans since before we were humans. Anyone who has the honor of cleaning a cat litter box knows about ammonia (it is a product of the decay of urine.) The smell of ammonia alerts humans to its presence at concentrations that are vastly below dangerous; this is one of the keys to safety around ammonia. If ventilation is adequate to remove the odor of ammonia, it is virtually certain to be adequate to remove the danger of ammonia.

Ammonia stings the eyes and nose because it dissolves in water very readily. Our mucous membranes (such as the lining of our lungs) contain a good deal of water, so they are very vulnerable. Ammonia dissolved in water forms ammonium hydroxide, an exceedingly corrosive substance capable of destroying human eyes and lungs at high enough concentration. The key to safety is to prevent this level of concentration from occurring (and this is very easy to do in the darkroom). The product sold as selenium toner is capable of generating this level of concentration only in very confined spaces, such as the interior of its storage bottle. Sniffing a tray of selenium toner working solution up close will provide a quick - and unnecessary - education.

When working with selenium toner, if the smell of ammonia becomes so obnoxious as to cause discomfort, a sick feeling, or stinging eyes, take it as a danger sign. Cover the tray and leave the area. Clear the air before returning, and make sure the level of ammonia in the air can be kept low.

Toxic contact with selenium toner in the darkroom cannot come via the air. It can come only from direct contact with the liquid solution. This is simple to control, although parents might not want to leave their young children unsupervised in the darkroom if selenium toner is in use.

Clearly, darkroom workers should keep their skin out of selenium toner. Need anyone be told not to drink it? Well, don't drink it! I have found the single-tray method of print processing to be very effective in controlling chemical exposure of my skin. I find it not just possible but very simple to keep my hands one hundred per cent free of chemical contact. This applies not only to selenium but all darkroom chemicals. The final result for me is that I can easily use selenium toner with no risk to my health whatsoever.

In the absence of proper ventilation, which really means the continuous removal of darkroom air and its replacement with fresh air, there are a couple of alternatives.

Probably the lowest-tech, cheapest (and perhaps most effective...) alternative is to

cover the tray while the selenium toner is in use. I have a feeling legions of darkroom workers over the eons have cut a piece of cardboard from a carton and laid it across the tray. Destroy it if it gets contaminated! The luxury version is made of clear, stiff plastic instead of cardboard. Washable!

The other alternative is to place a fan so it blows fresh air across the face and head of the worker. In a tiny darkroom this is not an option, but if there is enough volume of air in the darkroom, just circulating the air will suffice to deal with the ammonia odor. Many people who have cat boxes will understand the principle of diluting the scent until our poor insensitive noses can no longer detect it.

Here is a very effective strategy to deal with the smell of selenium toner: use both the above alternative methods, and use the single-tray method of processing.

If ventilation by bringing in fresh air is possible, of course use it. Many people have darkrooms that can't be ventilated this way.

Some darkrooms do have the availability of fresh-air ventilation, but winter conditions make its use impractical. The worker finds the room chills down too much. A "tray bonnet" might be the answer. Instead of allowing the room ventilator to draw air out of the room unrestricted, construct a small tent or 'bonnet' from coat hanger wire or some similar material. Cover the fame with lightweight, clear plastic. Make a hole in the side that will be closest to the ventilator outlet, and attach a length of plastic air duct tubing (the kind sold for venting clothes dryers should do nicely.) Connect this to the vent, and when using selenium toner, place the bonnet over the tray. This would be the best of all possible selenium-smell-control worlds: a cover on the tray to limit escape of the odor into the darkroom plus fresh-air ventilation with limited tendency to chill the room in winter.

For many years I noticed that the longer I used a KRST working solution, the darker and murkier it got. It continued to tone the print, but became progressively worse looking until I could not stand it and had to discard. In the course of working with - and storing - KRST at 1+5 dilution, I have learned...

...How to Keep Selenium Toner Working Solution Clear and Clean:

Selenium toner darkens with use because a dark precipitate forms as it is used. I'm not enough of a chemist to name the compound precipitated, but I do know three things to do about it.

First:
Eliminate one big cause of the precipitate: acid in the processing sequence preceding the toner. In other words, acid stop bath, and acid fixer. In my darkroom, I have replaced the stop bath with a quadruple water rinse when I make FB prints. A quadruple rinse is filling and dumping the tray four times

with plain tap water, with adequate agitation to rinse both sides of the sheet. This seems to be quite effective in removing the developer from the fibers of the paper. Developer left in the paper can cause stains later (in the fixer), because it can still develop exposed photosensitive material in the paper's coating. For this reason, among others, fixers have traditionally been acidic. Developing agents will not work in acidic conditions.

It should be noted that a conventional acid stop does little to actually remove developer from the print.

I do not use an acid fixer. Hence my desire to make sure no developer finds its way into my fixer. My fixer is the one Ansel Adams calls 'plain fix' in his book, 'The Print.' It's not really plain because it contains sodium sulfite as well as sodium thiosulfate, but it's plain enough. No hardener, no acid. No problems in the selenium toner.

This fixer has another major advantage as far as selenium toner is concerned: there is no need to rinse or wash between fixer and toner. The print can go directly from fixer to selenium toner.

For a complete treatment of my use of a non-acid processing sequence, please see the article on that subject elsewhere in the Technical section of this website. Also see the article on the Single-Tray method of print processing.

Second:
Filter the selenium toner working solution frequently. I filter mine both before and after a working session. I also filter the fresh concentrate out of the jug when I mix up a new batch.

Filtering can be time consuming. I have found that the coffee filters made to go into a plastic-basket style coffee maker work best. They are also the cheapest. They are flat-bottomed rather than conical. I have a plastic coffee filter basket that came out of an old disused coffee maker. This basket has a plastic mesh, and it holds the paper coffee filter well enough. I place the paper filter in the plastic basket, and the basket into a plain funnel. The purpose of the basket is to hold the paper slightly away from the wall of the funnel. This permits air to get between, allowing the liquid solution to penetrate the paper filter over a much larger surface. This means the filtering operation takes much less time, which means I will actually do it as often as I should.

Third:
Mix selenium toner with distilled water. Municipal tap water (or well water) might be acceptable, depending on where it comes from, but it also might not. There is no telling what substances are dissolved in municipal tap water. Distilled water will help eliminate one more uncontrolled variable in the use of selenium toner.

***Also*:**

I rinse out selenium toner containers both before and after use. When working with it, I keep my toner in a wide-mouth container in my processing sink, not in its own tray. This container gets pretty densely deposited all over its interior, and sometimes little specks of dried deposit come off. So I rinse before I use it. And while I am using the toner, I fill its storage container (the one that holds the toner when I'm not using it!) with tap water and let it stand for the length of my working session. At the end of the session, before I filter the toner back into its storage jug, I dump the water and rinse it out vigorously.

I keep my selenium toner away from all metals. Again, I don't have the chemical expertise to know if this particular toner is sensitive to metals, but the old-time conventional wisdom in photography is to keep metal away from toners. So I have scrapped the little stainless steel filter that was stuck into the plastic funnel I used in the past when I poured my toner back into its jug.

Capacity of a Selenium Toner Working Solution:

The instructions printed on the packaging of KRST rate its capacity as "at least 100 8x10 prints per gallon of toner diluted 1:3."

(As an aside, I've often wondered what this really means. The capacity is 100 8x10s per gallon of toner concentrate, which is diluted 1:3? In other words the gallon of concentrate will tone 100 8x10s, if diluted 1:3? Or do they mean each gallon of diluted toner, at 1:3, will tone 100 8x10s? I'd like the wording to be changed to, "at least 100 8x10 prints per diluted gallon of toner, diluted 1:3.")

In any case, that's a pretty low figure. A one gallon jug of selenium toner concentrate sells for over sixty-five dollars in Canada, and at 1:3 dilution the gallon makes four gallons of working solution. That means four hundred 8x10 prints can be toned for sixty five dollars. It's equivalent to one hundred 16x20 prints (my favorite print format), or sixty-five cents per 16x20. That's fairly expensive.

In practice, I have found that far more prints than one hundred per gallon can be toned. Here are some case histories of batches of selenium toner I have mixed and used:

Case 1:
Total usage - 202 8x10s.
Date mixed - Aug 10, 1999.
Date last used - Nov 24, 1999.
Dilution - 1 part (500 ml) concentrate plus five parts (2500 ml) distilled water for three liters working solution.
To top up solution (replace solution carried out by sheets during use) - 100 ml concentrate plus 500 ml distilled water added Aug 25, 1999.
100 ml concentrate plus 500 ml distilled water added Oct 26, 1999.

Case 2:
Total usage - 284 8x10s.
Date mixed - Dec 6, 1999.
Date last used - Mar 7, 2000.
Dilution - 1 part (500 ml) concentrate plus five parts (2500 ml) distilled water for three liters working solution.
To top up solution (replace solution carried out by sheets during use) - 100 ml concentrate plus 500 ml distilled water added on three occasions. This means that this batch of selenium toner working solution consisted of the original 500 ml concentrate plus 2500 ml distilled water totaling three liters, and later addition of 300 ml concentrate plus 1500 ml distilled water totaling 1.8 liters. This addition amounts to much more than fifty per cent of the original volume of the solution. I invested 300 ml of concentrate to extend the solution, where 500 ml would have made up a fresh one for me. Where to draw the line? Let your conscience be your guide.

My experience shows that solution loss due to carry-out is much more a determining factor in the number of sheets the solution can tone than chemical exhaustion. I don't think I have ever observed exhaustion of a selenium toner bath in the sense that it stops being able to tone the paper. Long before this point, the solution volume has dropped too low to be useful.

In my experience, a working solution of 1+5 KRST lasts perfectly well for four months. I believe it can last even longer; six months should be easily attainable. Again, it is carry-out of the solution that limits the length of time I can use it. I use it too often for it to have any opportunity to last six months.

The practice of diluting KRST with a working solution of washaid, such as Kodak Hypo Clearing Agent, is unwise if the solution is to be stored. The washaid oxidizes rapidly, and the toner solution will be unusable in a matter of days. This practice is suitable for highly dilute working solution that will not be stored.

Replenishment of Selenium Toner?

Case 2, above, suggests an interesting procedure. If the solution level is periodically topped-up by the addition of freshly prepared selenium toner working solution, can we continue this practice indefinitely?

I have not tested this specifically, but my feeling is that it will work as long as the solution is in regular use so there is frequent refreshment of the liquid. Might as well call this replenishment of selenium toner!

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