David Kachel's

Tray Processing in Tubes

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Tray Processing of B&W Sheet Film in Tubes

A Simple and Cheap Approach to Rotary Processing

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When I was young I was one of those photographers you try to avoid whenever possible. You know the type — I knew it all, and had plenty of sage advice for everyone, whether they wanted it or not. Worse, having read Ansel Adams' *Basic Photo Series* (thinking no one else had), in some cases I suspected I knew more than Ansel.

This was especially true when it came to the subject of sheet film processing. So, after buying a 4x5 view camera, I opted to ignore Ansel's advice about processing sheet film in trays, and instead purchased a small rectangular daylight tank for sheet film that was lauded hither and yon. The manufacturer's literature also assured me that I was indeed the smarter–than–Ansel fellow I thought I was, because, according to them, their tank would give me flawless, evenly developed negatives without the mess and tedium of tray processing. That sounded great!

It was horrible. That daylight tank produced the worst development I've ever seen, before or since, from any kind of approach, anywhere. In fact, I don't know of a single instance where sales hype differed more from reality. Unevenness was so bad that my negatives were useless, including those containing no sky or other smooth–toned areas. Repeated attempts to get acceptable performance from that tank produced not the slightest improvement in results. And believe it or not that same stupid lump of worthless plastic is still sold today, now from two or three different makers. But today, there is now *Facebook*, where every self-appointed *expert* sings the praises of this junk to any newcomer who will listen. And they do listen!

Somewhat humbled while cutting up those ruined negatives years ago, that one point was ceded to Ansel and some 5x7 trays for sheet film processing were purchased, and used successfully for years.

Along the way, however, I've tried just about every new gimmick or gadget to come along, both cheap and expensive, in the hope of finding a better way. I've used small tanks, deep tanks, hand tanks, rocking agitation, inversion agitation, nitrogen burst agitation, and the old Kodak standby of lifting aluminum hangers from the open tanks and tilting them to either side. I've tried nearly every conventional alternative, and the results have always been the same: awful! It seems unavoidable that the channels in reels or holders for sheet film will produce uneven development or bubbles along the edges of the film and that other structures in the tank, holder, or reel will cause uneven agitation and development. Apparently, structures of any kind, whether holding the film or just in close proximity to it, will produce uneven development. This makes tank development of sheet film a guaranteed losing proposition, by definition.

Aside from tray processing, there is only one other approach that does the job correctly: *rotary processing*. Rotary processing places the sheet of film, gently curled up inside a tube. The tube rotates in developer instead of being turned end-over-end.

When this paper was originally written there were two options for rotary processing…

One was the Jobo "Expert" drum. I hadn't used this myself, but John Sexton, who owns and uses them, assured me it was excellent. In this case —considering the source — it was safe to ignore the usual rule against anecdotal evidence and accept what he said. Well, the Jobo may be a great system, but for a "working poor" photographer, not a neurosurgeon, it was out of the question. Jobo's were and are, expensive! Even if it were more affordable, the Jobo system probably wouldn't have been the right approach for me because it doesn't allow individual sheets of film to be pulled out while others continue to process — an important part of my way of working. Any approach that starts with the premise that all film being processed at the same time should all be processed *for* the same time, is a non-starter.

The other approach was using Phil Davis' BTZS tubes, also still around (Davis is not) but at $175 for just six tubes, still hardly a bargain. These are based on a concept similar to both the Jobo Expert drum and the technique I'm getting ready to relate to you, and, again, a number of people whose opinions I valued had told me they worked well, so again the point was conceded.

While it's true that tray processing yields results vastly superior to most any other approaches, that doesn't mean it's perfect. Until the time of the original incarnation of this article, it had just been the least of numerous evils. It tends to develop the edges of a negative slightly more than the center, and can sometimes produce unevenness or mottling (though this is seldom severe). Far worse is the risk of scratching or gouging the emulsion due to the necessity of constantly handling the negatives in a small tray. This wasn't much of a problem when using Plus-X and Tri-X Professional — these films are hard to damage on purpose, let alone by accident — but when T-Max 100 and 400 came along, problems arose. With these films, the tried–and–true tray shuffling technique produced severe scratches and gouges, far more often than was considered acceptable.

All it took to scratch these otherwise fine films was a hard look! Some new way to process sheet film, other than in trays, had to be found.

The search was pretty easy. Aside from trays and tanks there is only rotary processing. If a sheet of film is curved inside a tube, there is essentially nothing but pressure holding it in place — no channels or other structures to produce currents that result in uneven development.

Rotary processing of sheet film has been around for quite a few years now and works extremely well. Development is more even than is the case with tray processing, and there is extremely little risk of damaging the film in handling.

The Jobo Expert drum and Phil Davis' BTZS tubes are the two basic choices when it comes to rotary processing. Both are intended for lights–on use, having sealed containers in which small quantities of developer are placed. The tubes are then tipped over and rotary agitation begins.

The reason I didn't go with either of them, in addition to cost, is that I'm not crazy about the idea of fiddling with closed tanks or end-caps all the time, while employing a number of techniques which require introducing new chemicals into the tubes in total darkness. Pre-soaking or employing a SLIMT bleach prior to development are two examples. To say the least, this would be very awkward.

Also, if you process a lot of sheet film from a day's shooting, the thought of measuring out small quantities of developer for each individual sheet of film, over and over, is not very attractive either. In the past the wisdom of development in the relatively small amounts of solution usually associated with rotary processing systems has been questioned by quite a few. In my opinion, most cases of uneven development or mottling associated with rotary processing can be traced to the small volume of chemistry permitted by the rotary tube. Others have drawn this same conclusion.

I needed an approach to rotary processing that would permit me to use quantities of developer similar to those employed in tank or tray development so as to be sure of the availability of an adequate volume of developer. And, I needed to be able to change solutions quickly without fumbling in the dark with small parts and without having to measure numerous small volumes of solutions in advance.

What was not required was an approach which allowed me to work in room light in between changes of chemistry. To me, it makes no difference whether I am standing at the darkroom sink agitating film with the lights on — or off. Either way, one must stand there, pay attention to what they are doing, and keep an eye on the clock. Room light isn't a must.

In other words, I needed a way to make rotary processing in tubes work for me. It was easily found and was also quite simple and inexpensive;

So here, adapted for my needs and maybe yours, is my "ultimate simplification" of the rotary processing approach:

- Visit your local hardware store and buy a length (your needs will determine how much) of white (thin–walled, schedule 125) PVC pipe. Other schedules should work, too. Here are the outside diameters:

1 & 7/8 inches for 4"x5" film
2 & 5/16 inches for 5"x7" film
3 & 1/4 inches for 8"x10" film

Or, just take a sheet of film to the hardware store with you and try it out there. You want the long dimension of the film to run parallel with the length of the tube. Curl it emulsion side inward and slide it into the tube. The PVC will have rough edges, but that gets resolved later.

This is a hard plastic tubing generally intended to be used for plumbing. It comes in 20–foot lengths, or whatever shorter length you may wish to purchase. They'll be happy to cut the length you require.

Also buy a hack–saw with 32 teeth per inch, some sandpaper in 320 and 600 grit, and a razor blade knife.

- Cut the pipe into 6–inch, 7–inch and 8–inch lengths for 4x5 inch film; 8-inch , 9-inch and perhaps 10-inch (you may not need the 10-inch) lengths for 5x7 inch film, and 11-inch and 12-inch pieces for 8x10 inch film. Or choose lengths more appropriate for your needs. Just make sure you can get the sheet of film all the way into the tube with at least a half inch of play at each end and that they are not too long to fit within the short dimension of the tray you plan to use.

Why the different lengths of tube? That's easy. It allows you to process different sheets of film for different lengths of time without having to count or otherwise keep track of which film is which, during development.

- Use the razor knife to scrape the shavings off the ends of each tube, then sand the ends with the 320 grit paper followed by the 600 grit paper, until smooth. Or you can use a Dremel-style tool to buff the ends out in no time. Beauty doesn't matter, a good thing with that Dremel too! Wash out the tubes in soapy water, then rinse and dry. You are now ready to process.

- Set up your darkroom exactly the same way you would for tray processing of sheet film, including pre–soak, etc. The only difference is that you must use larger trays. I use 11x14 trays for my 4x5 and 5x7 film, a 16x20 tray for 8x10 film. For 4x5 film I use 1.5 liters of chemistry in the 11x14 trays. To be sure, put two or three tubes in an empty tray, fill with water to where you are sure the film would have adequate exposure to developer (about a third of the way up the center of the tube), then measure the liquid. That is the amount of developer, etc., you will need for that size film.

- Select several negatives to be processed (depending on the size of your trays) and insert the negatives — with the film-base side in contact with the PVC surface — emulsion facing the center of the tube — into the tubes.

- Check your fingernails. If you can tell whether they are clean or not, you forgot to turn off the lights before putting the film into the tubes. No end caps… remember?

- Drop the tubes into the first tray and begin processing by rolling the tubes from one end of the tray to the other, making certain they are rotating as you push them. This rolling should be done continuously throughout processing, smoothly and at a consistent pace. Keep rhythm with the clock. Most people wear rubber gloves for this. You don't have to perform any dedicated manipulations with this form of processing, so the gloves should not be a hindrance.

- When development is complete, lift all the tubes from the tray, tilt to drain, and move them into the stop bath tray, continuing rotary agitation. Or, if processing for different times, lift the appropriate length tube out, drain, immerse in stop bath tray and continue processing in development tray with the one hand while rolling the tubes in the stop tray with the other. I have found it convenient to use plain water as a stop, just in case I absent-mindedly stick that hand back into the developer. Move them from tray to tray in the same manner after each step is completed. The tubes in the stop tray can remain there until all the rest of the tubes are done in the developer.

- After a minute in the fixing tray, turn on the lights and remove the film from the tubes, placing it into hangers or smaller trays for fixing and washing in conventional tanks or trays. The reason for this is that you cannot thoroughly was film in the tubes. Also, the center of the back side of each film sheet will have been pressed tight against the wall of the tube and will therefore not have allowed the fixer to adequately remove the anti-halation dye from the base of the film. Sheets appear to be horribly stained after removal from the tubes, but this quickly and completely disappears after a few minutes fixing in conventional tanks. If the stain is stubborn, give the film a few minutes in sodium sulphite at ten percent to hurry the process. The stain will usually come out in subsequent washing anyway.

- After use, rinse and dry the tubes, then use again.

Results from processing in this manner have been wonderful over nearly a quarter century of use. There are never any scratches on the film from development. Development is significantly more uniform than that provided by conventional tray processing and I can continue to take the same basic approach to processing sequences as always used.

There is one minor flaw involved in tube processing, whether by this method or any other. As mentioned previously, because the center of the reverse side of the sheet of film is pressed against the wall of the PVC tube, fluid cannot readily reach this area and the film is left with a broad watermark down the center of its length. It is ugly and not removable, but cosmetic only — it does not show up in prints. Even making some grade 5 prints with a condenser head enlarger in order to give this watermark every opportunity to show up on the print showed no defects. (In recent years I don't recall having this watermark occur at all. Perhaps something has changed about film manufacturing.)

To minimize the watermark, if you find it offensive, pre–soak in a mild Photo-Flo bath. You can also lift the center edges of the film during the pre–soak to allow water to penetrate more thoroughly to this area. Again, this watermark does not show up on prints and is therefore of significance only to those of us who are compulsive perfectionists.

To test the effectiveness of this new approach, a number of sheets of film were tube processed, all exposed to a uniform light source (my enlarger). One identically exposed sheet of film received traditional tray processing, as a control.

All of the negatives were then printed on grade 4 paper (to enhance defects) for a light midtone.

Densitometer and visual measurements of the tube processed negatives showed no variation in density whatsoever across the negatives.

Densitometer measurements of the tray processed negative also showed no variations in density across the negative. However, it is a little–known fact that the human eye is more sensitive to density and color differences than the conventional densitometer and is therefore sometimes a more useful tool. Visual inspection of this negative showed a certain lack of uniformity from center to edge, along with some mottling.

The tube processed negatives showed no scratching of any kind. This was of course, a highly gratifying result, because it was my primary goal. The prints made from all of the tube processed negatives were significantly more uniform than the print made from the tray processed control negative. Two separate test batches, consisting of six negatives each, were tube processed. Density was extremely uniform across all of the negatives, both sensitometrically and visually. Within each group, all negatives in the group measured exactly the same density on the densitometer. Neither did they show any visual differences in density.

Conclusion

I shuffled my last stack of sheet film in the 1990's, once realizing how well this technique was going to work, I went back to the hardware store and bought more PVC. For approximately a $10 investment at the time (Already had the hack–saw and the razor knife.), This resulted in 40+ tubes of varying lengths for processing 4x5 film and a substantial day's work could be processed without stopping to wash or dry a tube.

I still process film in trays, but each sheet is rolled inside its own individual length of PVC tubing. With this approach I get substantially more uniform development, no longer have to worry about scratches, do not have to count sheets as I'm processing, need to concentrate less on what I'm doing while agitating, and can continue to use any of the specialized techniques that have become customary over the years. This is definitely the best approach for the dollar that I know.

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