

Tetenal E-6 3-Bath – No longer a complete mystery!

E-6 – the code for colour slide development - still radiates a special magic for many photographers. The process remains the crowning point of photography. The accomplishment of high contrasts and natural yet brilliant colour reproduction are advantages not achieved by any other photochemical process currently available. Excellent results require great skill and precise work – which applies to both, the exposure during shooting and subsequent chemical film development.

No other development process involves as many baths, is as complex and takes as long as the E-6 process – yet it has been a proven process since it was launched by Kodak in the mid-1970. Since then, only a few modifications have been made. The same developer machines are still in use in specialist and finishing laboratories today.

In the E-6 standard process, the films undergo a total of 7 different baths, plus two additional rinses. Without drying, the time from the first developer to entering the dryer is approx. 33 minutes. By comparison: a colour negative film in a modern, fast C-41 RA process is already developed after 7 minutes.

E-6 Standard development in hanger developer machines

| Process step | Time Min | Temp. °C | Reg. Rate ml/m ² |
|------------------|----------|----------|-----------------------------|
| First Developer | 6 | 38 ± 0,3 | 2150 |
| Wash | 2 | 33 - 39 | |
| Reversal | 2 | 24 - 39 | 1100 |
| Colour Developer | 6 | 38 ± 0,6 | 2150 |
| Pre-Bleach | 2 | 24 - 39 | 1100 |
| Bleach | 6 | 33 - 39 | 215 |
| Fixer | 4 | 33 - 39 | 1100 |
| Wash | 2 | 33 - 39 | |
| Stabiliser | 1 | 20 - 39 | 1100 |

For the E-6 standard machine development process, the individual baths of the process are replenished, i.e. fresh chemicals (replenishers) are pumped into the respective working solutions of the machine containers in proportion to the material throughput of films - the resulting overflow is collected in special containers which are later disposed of by specialist companies.

The exact dosing of specially formulated replenisher baths compensates the chemical losses in the working solutions and keeps the process stable, provided there is good and even utilisation.

And here is the problem: the mechanical processing in the replenisher process is not suitable for small laboratories and studios with low as well as strongly fluctuating utilisation.

The solution for this clientele came in the late 1970s when JOBO launched the first colour processors for rotary development. It is not replenished but always developed in a small amount of fresh chemicals (working solution). The chemicals used here are based on the standard formula for E-6, adapted to the requirements of rotary development with drums.

At that time, all major photochemical manufacturers had E-6 working kits in their range: Kits for 1 litre or for 5 litres. The technical update - small machines in combination with kit chemicals - means (geographic) independence for every studio, for every photographer – time-consuming trips to the nearest specialist laboratory in a larger city or mail orders are no longer necessary for users.

Despite all the positive progress - the E-6 standard process still had a major disadvantage for rotary users: the comparatively long processing time and time-consuming mixing of 6 baths plus a final stabilizer bath.

The significant breakthrough came in 1987 when Tetenal launched the E-6 3-Bath process. This process uses 3 baths and stabiliser instead of 6 baths plus stabiliser.

Only half as many baths – only half the effort and consequently an enormous saving of working time.

The key feature of the E-6 3-Bath process lies in the merged individual process steps, which already work combined, with unchanged basic formulas for the imaging baths of first developer and colour developer at the same time.

- Instead of a separate Reversal, the reversal substance is an integral part of the Colour Developer.
- Instead of the separate Pre-Bleach, Bleach and Fixer steps, the 3-Bath process works with a combination of these baths, grouped into one Bleach-Fixer.

E-6 3-Bath development in JOBO rotation

| Prozess step | Time (Min.) | Temp. °C |
|------------------|-------------|----------|
| Preheat the drum | 5:00 | 38 ± 0,3 |
| First Developer | 6:15 | 38 ± 0,3 |
| Wash | 2:30 | 38 ± 0,5 |
| Colour Developer | 6:00 | 38 ± 0,5 |
| Wash | 2:30 | 33 - 39 |
| Bleach-Fixer | 6:00 | 33 - 39 |
| Wash | 4:00 | 33 - 39 |
| Stabiliser | 1:00 | 20 - 25 |

First Developer

The First Developer is a soft working b/w negative developer - very fine-grained, deliberately slow in image formation despite the comparatively high temperature of 38°C. The exposed silver halides are reduced to metallic silver evenly in all 3 emulsion layers sensitive to blue, green and red light. Non-exposed silver halides remain unchanged.

The first development is the only really critical step with E-6 development, the parameters of sensitivity, contrast, minimum density, maximum density and colour density are substantially influenced here, possible errors cannot be corrected during further processing steps. Overdevelopment occurs when the concentration is too high, the time is too long or the replenishment rate is too high – conversely, underdevelopment occurs when the concentration is too low, the temperature is too low, the time is too short or the replenishment rate is too low. Overdevelopments in the First Developer result in flat, overly bright slides - underdevelopments result in dense, overly dark slides. This effect can be exploited when pushing or pulling films, meaning intentional overexposure or underexposure, to then counter with a changed first developing time.

The First Developer in the E-6 3-Bath process is identical to the First Developer in the E-6 standard process.

First Wash

In the First Wash the remaining First Developer solution is removed from the film, resp. replaced by water. This exchange creates an abrupt stopping effect – it happens first in the above layers, subsequently in the mid and lower layers, a controlled and programmed sensitometric effect.

If the washing is inefficient, the development is still ongoing in the lowest layers, while in the above layers the development has stopped. Thus the First Wash is an important step in the reversal process – understandable that the temperature of the water, the time as well as the washing rate must be exactly maintained. In the standard process as well as in the 3-Bath process.

Colour Developer

And now to the Colour Developer, whose chemical structure in the 3-Bath process is almost identical to that of the E-6 standard process. But there is a major difference: the reversal substance in the 3-Bath Colour Developer is already integrated in the formula, whereas reversal in the standard process is done in a separate bath after the first wash and before the Colour Developer.

The purpose of the reversal bath is to convert the unchanged silver halides that remained in the First Developer into developable silver halide. In the E-6 process the emulsion absorbs a chemical reversal substance in a separate reversal bath, but it can only develop its effect in the alkaline environment of the subsequent Colour Developer.

The 3-Bath process employs a special “cover-up tactic”: instead of a preceding oxidation-prone separate bath, it uses a highly active reversal substance, directly integrated into the colour developer formula.

A simple yet ingenious basic idea: if the reversal substance needs to be transported with the emulsion into the Colour Developer, this substance can be integrated right there. However, this would not work in the replenished mechanical process, since the 3-Bath process does not offer reverse integration.

The E-6 Colour Developer is tolerant, the photographic result is practically independent of small temperature differences, different rotation speeds and even processing times. The time may vary, up to plus/minus 2 minutes from the target time, without visible differences in colour and density.

The E-6 Colour Developer is, however, very sensitive at one point. The high pH value of approx. 12 and low buffering mean that it easily absorbs carbon dioxide from the air, which inevitably reduces the pH value. Decreases or increases, however, change the colour balance. The problem is that the blue-sensitive layer (yellow curve) hardly depends on the pH value, while the green-sensitive layer (magenta curve) reacts strongly, while the red-sensitive layer (cyan curve) shows an average influence.

A magenta-blue colour shift occurs if the pH value is low, and the balance is shifted towards yellow-green if the pH value is high.

Advice: Always seal the Colour Developer bottles, never leave them open!

Intermediate Wash

Alkaline Colour Developer is rinsed out of the emulsion to maintain the pH stability of the required acidic environment of the bleach-fix-er bath. The pH value in the Bleach-Fix would inevitably increase without this step, causing a braking effect which would reduce or even cancel the bleaching.

Bleach-Fix

The Bleach-Fix in the 3-Bath process combines the processes Pre-Bleach, Bleach and Fixer. An essential component of the Pre-Bleach in the E-6 standard process in developer machines is a bleaching accelerator which accelerates the oxidation of the image silver in the following bleaching step. The accelerator in the 3-Bath process is an integral component of the Bleach. Simple but effective!

With mechanical processing in hanger and continuous machines, the Fixer directly follows the Bleach without intermediate wash. The Fixer in the replenished process is in fact a Bleach-Fix due to the introduced Bleach.

The 3-Bath process works exactly the same way: instead of bleaching and fixing separately, it is combined, which has been industry standard for decades in paper processing, for example in the RA-4 process.

Final Wash

In the Final Wash, residual chemicals from the previous process steps are rinsed out of the emulsion and removed - obligatory for all forms of E-6 development.

Stabiliser

The name says it all: the last step in the process ensures chemical stabilisation, preventing subsequent changes in the dye molecules and ensuring the durability of the colour slides. Wetting agents in the Stabiliser allow residual liquid to drain off evenly, important for drying to occur without spots and streaks.

Since its market launch in 1987, the E-6 3-Bath process has found many enthusiastic fans worldwide and has already outstripped the E-6 Standard Kit - also for the rotation - after just a few years. Today, Tetenal only has E-6 3-Bath chemicals in its range - a clear market decision.

Aren't there any disadvantages to the E-6 standard process?

Absolutely none - if the process is carried out correctly you will always achieve excellent reproducible results. Absolute cleanliness of the equipment used is essential, including a clean water jacket bath in the processors and perfect tightness of the cog lids and the sealing rings on drum covers and lifts.

After each development cycle, the spirals and drums used must be thoroughly rinsed with water in order to blow them dry - ideally with a hair dryer.

First Developer and Colour Developer must be prepared in separate mixing containers, never leave open First Developer and Colour Developer next to each other!

Since cleanliness in the photo lab is a basic prerequisite for good results, the described requirements and work recommendations are not limited to the 3-Bath process, they should be followed either way.

351734 / 01
27-06-2018