Correct exposure time of stencil and Equipment limitations

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Most of the problems that involve the screen or stencil are related to exposure of the stencil. Mainly underexposure represents the biggest threat for the screen maker. Underexposure can lead to a multitude of difficulties during the print run and afterwards when the screen should be reclaimed and reused. The screen maker is not always to blame, as it might be the screen room equipment that dictates the screen quality. This article will expose these equipment limitations and shed some light on the question how to determine exposure times.

What happens during exposure?

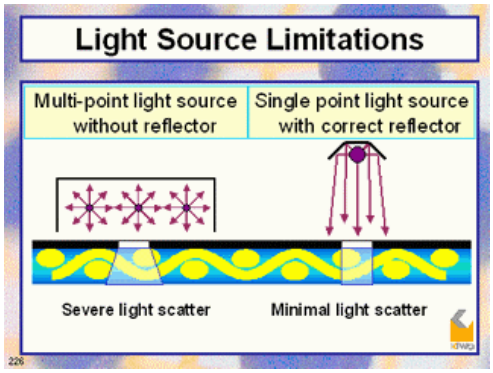
The purpose of exposing the stencil is of course to image the screen, or to reproduce the artwork on the "printing plate". That, however, is only one task we have to accomplish. Just as important is, that the emulsion changes its chemistry. It transforms from a water soluble material to a water resistant and solvent resistant material during exposure. Only after exposing or "cross-linking" the emulsion correctly is the stencil tough enough to withstand the torture of printing. Imagine that underexposure is similar to sawing on the link of a chain. The stencil is only as strong as its chemical bonds of links are, just like a chain.

Can your equipment limit the screen quality?

Modern stencil systems such as Diazo, Diazo-Photopolymer and SBQ-Photopolymer emulsions can handle all possible requirements. Be that short print runs with plastisol inks, thousands of 4-color posters with water based UV ink or several hundred thousand prints on bottles with solvent based inks. The problems start when the screen maker is limited by the equipment and can not expose the emulsion properly.

What are you looking for in a stencil? All you want to see is that the artwork is reproduced as true as possible. However, not all exposure systems are able to do that AND crosslink the emulsion fully. Depending on the design of the exposure lamp, you may have to underexpose the screen to hold fine detail.

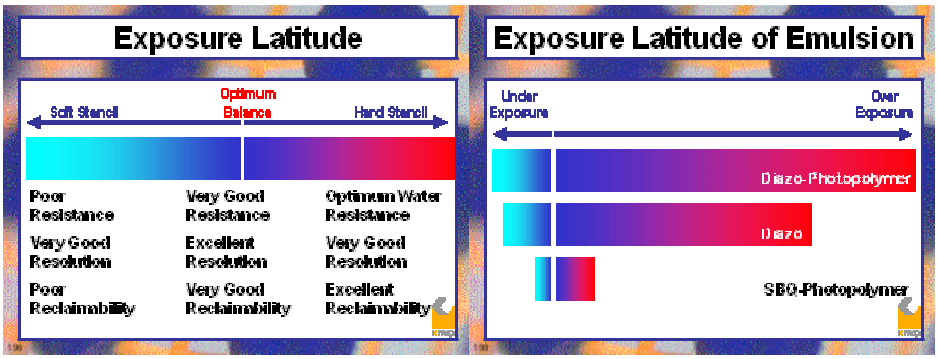
Because of severe light scatter caused by the lamp design fine detail will close in when exposing too long. But, too long for the lamp may not be enough for the emulsion. Consequently the emulsion is underexposed which may lead to pinholing and premature stencil break-down.



It is essential to use a lamp design that provides collimated light output which minimizes light scatter through a lamp design that directs the light straight onto the screen. Ask for the resolution of the lamp and ,make a few test screens before you purchase an expensive exposure system that promises high resolution but can not harden the emulsion to the correct level.

What is the correct exposure time?

Correct exposure time should be described as the level of crosslinking that is sufficient for the required resistance of the stencil. That means that in some cases it might be necessary to stay closer to the lower end of the exposure latitude. In other cases it could be desirable to expose as long as possible and even loose some detail.



Good emulsions have a wide exposure latitude, which is the available window for exposing the screen. The lower end represents the maximum resolution, the higher end marks the optimal resistance. In reality you have to choose between those extremes and find the point of exposure that suits your application and requirements best. When using high quality exposure systems, you will find that our emulsion can hold extremely fine detail even at the point where they are completely crosslinked. Of course some emulsions, such as basic Diazo emulsions, may simply not offer such high resolution.

How to determine correct exposure

There are two ways to determine exposure times that work with all emulsion systems.

•step exposure

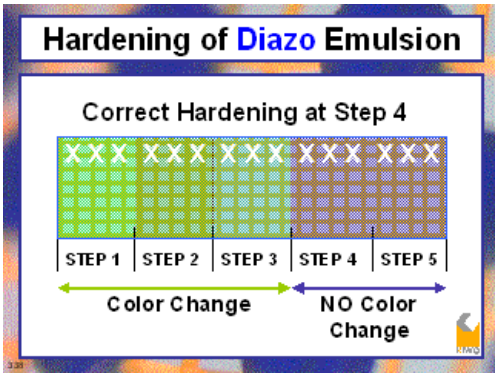
•exposure calculators

Both are essentially the same with only one difference. The step exposure allows you to set the steps to your liking and can be set so close that a more accurate reading is possible. Exposure calculators have preset steps which are determined by the neutral density filters behind the image and offer the advantage that only one exposure time has to be set.

In either case the exposure time covers the entire exposure latitude, ranging from severe underexposure to overexposure. When using the exposure calculator the screen should be exposed at approximately twice the estimated exposure time. In case of a step exposure it depends on the number of steps and the test film.

What to look for when judging exposure time

Different emulsion systems require different ways to determine exposure time. The main systems are DIAZO sensitized emulsions and pre-sensitized emulsions such as SBQ-Photopolymers.



Diazo has the big advantage of showing a color shift from yellowish to the neutral color of the emulsion. The yellow comes from the sensitizer and disappears once the Diazo is reacted, i.e. the crosslinking is completed. Usually you can see a distinct color difference between the steps, up to the point of complete crosslinking. The step that dose not show any color difference to the following step is typically the correct exposure time. The resolution, or the amount of detail that is visible at this step depends on a variety of variables:

- **the quality of the exposure lamp**
- **color of the mesh**
- **the thickness of the coating**
- **color of the emulsion**
- **maximum resolution of the emulsion**

- **age of the emulsion**
- **exposure latitude of the emulsion**

In any case the color shift is probably the best way to determine the correct crosslinking of Diazo sensitized emulsions.

Overexposure is a little more difficult to recognize, as there is a difference between white and dyed mesh and on top of that, a poor lamp system can show signs of overexposure despite underexposing. Any diffuse light creeping underneath the edge of the artwork will produce signs of overexposure.

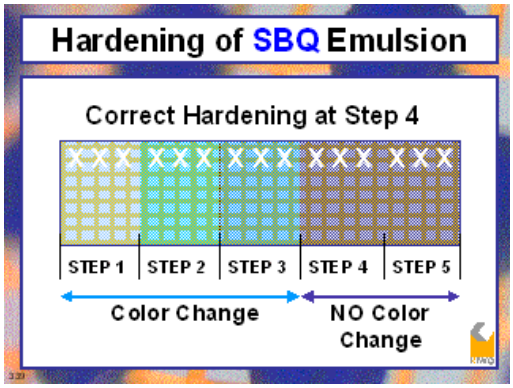
To avoid confusion about whether the emulsion is overexposed or the lamp is poor, check the first step without color change. If that step, which is the step of correct looks over exposed it is probably the lamp.

On white mesh you will see that the emulsion starts to harden around the threads that run away from the emulsion edge, creating a severe sawtoothing. On dyed fabric overexposure simply starts to close in fine detail without noticeable change in edge quality.

How to judge emulsions that don't change color

Pre-sensitized emulsions that use SBQ or similar sensitizer systems don't change their color during exposure. These emulsions usually have very fast exposure times and short exposure latitudes. All those features may be desirable for the screen maker, but make it more difficult to determine the correct exposure time.

Instead of looking for a color change after the screen is developed and dried, you should look for a color difference between the steps at the moment of developing. Most emulsions will change the color to a more milky shade when they first come in contact with water during developing. The underexposed areas will be milkier or whiter, whereas the steps beyond optimal crosslinking do not change anymore. The milkiness may still be present, but there is no difference between the steps. This type of color check has to be done on the squeegee side of the screen and at the moments following the first contact with water.



Another method to check these types of emulsions and all others as well is to look at the developed and dried screen. You may want to place the screen in front of a light source and view it at a very low angle. If the light falls right onto the squeegee side of the screen you will see differences in gloss between the steps. The duller steps are those steps where the emulsion was not hardened all the way through and the underexposed emulsion washed off on the inside of the screen. The dullness comes from the exposed knuckles and swelling of the emulsion. The steps that show no change are normally exposed sufficiently.

Conclusion

Using the right exposure time for an emulsion is essential to avoid many problems. Pinholing, sawtoothing, poor resistance's, difficulties in reclaiming and excessive emulsion haze are typical signs of underexposure. All those can be avoided if the emulsion is exposed correctly. Unfortunately, the equipment available may limit the possibilities and require underexposure in order to hold fine detail.

To compensate for shortcomings on the equipment side, emulsions offering a wide exposure latitude, very high resolution, excellent resistance's and a relatively dark dye, such as our KIWOCOL POLY-PLUS emulsions can be used.

These emulsions offer a high level of tolerance and thus production security with a minimal amount of rejects.