

Filter fulfilment 2

By Alexander Mustard

Back in UWP 11 Peter Rowlands wrote “Filter Fulfilment” an article encouraging us to use coloured filters as the alternative approach to using flash to get colourful underwater images. My aim in this follow up article is not to convince you that this technique works with before and after shots; PR’s article convinced me! Here, I plan to go into a bit more detail and pass on some of my ideas about how to get the best out of this technique of combining coloured filters with a digital camera.

Colour compensating filters have been used in underwater still photography for many decades. Seek out a 1960s text and you will find lots of filter facts, but reading between the lines and it appears that filters were popular only because flash photography was, at best, temperamental and at worst, darn dangerous! Even the most experienced users of filters would struggle to get the exact colours they wanted - colours that could be so easily achieved with flash. Once electronic strobes got through their teething problems the popularity of filters waned.

The theory

A colour compensating (CC) filter is used underwater to attenuate undesired wavelengths (read colours) and to transmit desired wavelengths of light to counteract the filtering effect of the water. Correct filtration balances the full spectrum of



Digital cameras make getting colourful shots without flash very simple. Nikon D100, Subal housing. 16mm lens. 40CC Red filter. 1/100th @ f9.5

wavelengths, the wavelengths we would usually supply with our flashgun. It is important to remember that filters, either in the form of seawater or the one on your lens, work by subtraction, they can only take away unwanted wavelengths. So in filter photography we are always reducing the light that is available.

As an example, in clear water red, yellow and orange light is attenuated and the resulting spectrum is biased to cyan/blue. To counteract this we must add a red filter that will get rid of all that unwanted cyan and blue and flatten the spectrum (although at a much lower intensity that the original light). The reason this technique is never particularly effective on film is that the exact filter required to “correct” the spectrum depends on what light has been removed by the water,

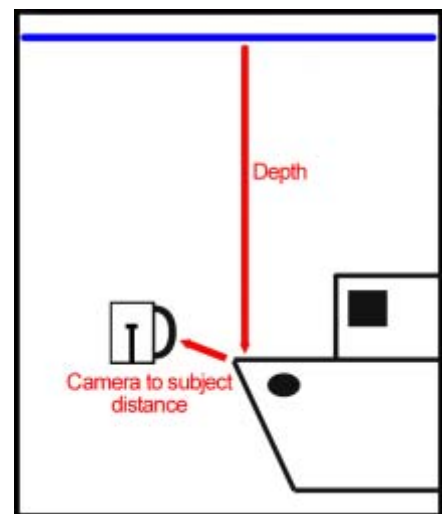


Figure 1: The right path: the important light path to determine the strength of filter required is the one from the surface to the subject and on to the camera.

which is mainly determined by the distance the light has travelled through the water. This crucial “light path” distance is measured from the surface to the subject and on to the camera (see

Figure 1).

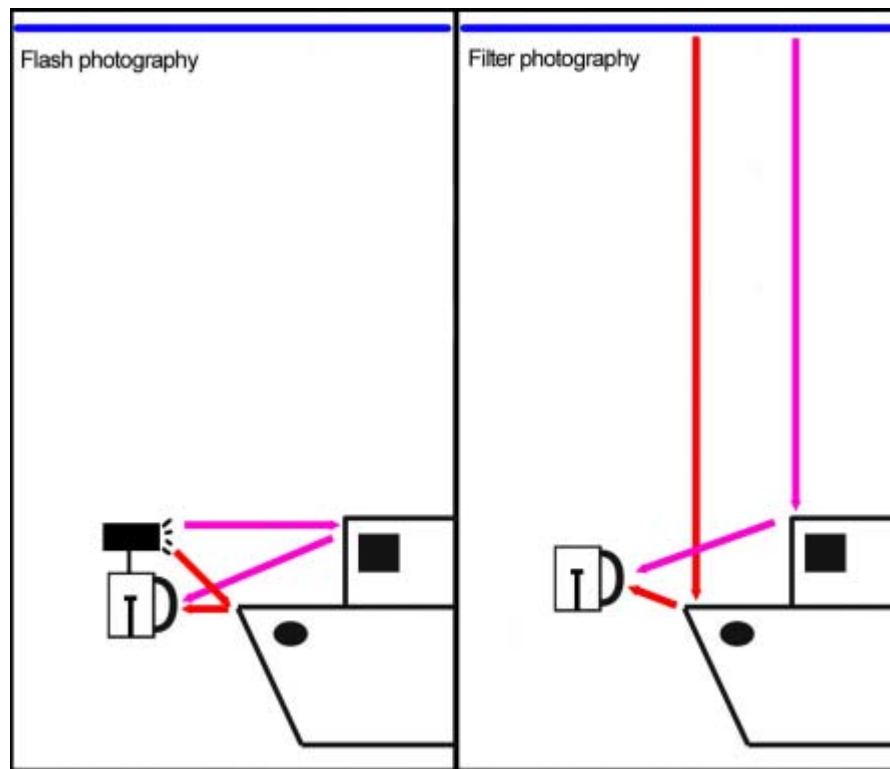
Thankfully photographers have already determined empirical equations to guide us to the right filter. For example, in tropical (cyan) water we need 12CC units of red filter for every meter of light path. So at a depth of 3 m, 0.3 m away from the subject, we need a 40CC red filter (12 x 3.). The exact filtering requirements will depend on your local conditions, but I would recommend this as a good starting point.

As I'm sure you have already realised this means that a particular filter will only work at a specific light path length (or depth). And this lack of flexibility is really the big weakness of the technique when used with a film camera. Furthermore, a film system cannot react to other factors that change the colour temperature of the light, such as changes in water quality or the light above the water (clouds, sun angle etc).

However, with a digital camera we can easily tilt the playing field back in our favour. Digital cameras have adjustable white balance designed to counteract changes in colour temperature of the light. This factor adds the flexibility to filter photography that makes this technique a real alternative approach to colour photography. In Filter Fulfilment 1 PR shows convincing before and after shots taken with a URPRO filter from a depth of a few metres to close to 20m.

The toys

Rather unusually in the world of underwater photography this is a technique that doesn't require you to part with lots of the folding stuff..



Relative values: in available light photography we get better colour penetration into our pictures because the relative light path lengths of the light are much more similar between the foreground and background than in flash photography

Instead it is more a case of leaving behind many of your normal toys. So cast aside your strobes, your strobe arms and your synch cords! The only new purchase required is a filter.

As a starting point I would recommend using a CC gel filter (such as a Kodak Wratten filter) that can be cut to fit on the front or rear of your favourite wide angle lens. Established wisdom suggests using a magenta filter in green and deep water and a red filter in shallow cyan/blue water. Then use 12CC units per meter of light path to work out what strength of filter you want. But since the use of filters in digital still photography is only just getting going it is really worth experimenting to find the best setup for your camera, local conditions and usual diving depth. Being able to see your images after every dive makes it easy and quick to find which

filter works best.

As an alternative to CC gels you could try fluorescence warming filters or the URPRO filter range. I have found the knowledge and experience of the users of the wetpixel.com forum a great source of information in these matters, and using this internet group I have even been able to bounce ideas off the forum while out in the field!

White balance and RAW files

White balance is simply an image processing control on a digital camera that adjusts the colours of the image to compensate for changes in the colour temperature of the light illuminating the subject. When white balance is set to AUTO, the camera measures the colour temperature of the illumination and alters the colours of the final

image as it processes the data from the CCD. And most of the time this works very well.

In underwater photography (with or without flash), if we are too far away from our subject the resulting image comes out too blue. AUTO white balance can detect this blue shift in colour temperature and removes it in the processing. That is why we can get away with shooting a digital cameras from further away than a film camera. And why digital cameras make novice photographers happy, who have not yet learned to get close. I have become side tracked!

I suggest starting filter photography by using AUTO white balance and shooting RAW format files. When using the RAW file format the white balance settings do not change the data recorded by the camera's CCD, which is what the RAW file is. Do note, however, that the preview image shown on the LCD screen will have the white balance applied to it. RAW files allow us to adjust the white balance after the dive, on the computer, if we are not happy with the result. Changes made to the colour temperature and exposure at the RAW conversion stage are much less detrimental to image quality than similar changes would be made to a bitmap file in Photoshop. This is because we are modifying the original data captured by the sensor before the bitmap is created. RAW conversion software, such as Adobe Photoshop Camera Raw, provides this post production control. Many photographers prefer to shoot on AUTO and fine tune white balance in this way, while not under the influence of compressed air.

I prefer a slightly different



Filters are a great way of taking colourful pictures in turbid water, which would produce lots of backscatter under strobe lighting. Nikon D100, Subal housing. 16mm lens. 40CC Red filter. 1/320th @ f5.6



Colour penetration away from the camera into the image is much better in filter than flash lit shots. Nikon D100, Subal housing. 16mm lens. 40CC Red filter. 1/40th @ f6.7

approach. I take a plastic grey card underwater with me to determine my own white balance setting for the shooting conditions. The way I do this is to show my camera the grey card - my camera already knows what a grey card should look like and calculates a white balance by comparing what it sees to what it

expects. I then use that setting for my subsequent shots. Other cameras know lots about white cards, it just depends on how they have been programmed. A manually calibrated white balance will only work at one depth, so if I am moving up or down the water column over a few meters, and thus changing

the length of the light path, I have to recalibrate the white balance. I keep my grey card stuffed under my BC's cummerbund, and the calibration takes about 10 seconds. If I am only moving up or down less than a meter I tend not to bother recalibrating the white balance, instead relying on adjusting the colours in the RAW conversion software.

So if RAW conversion software or in situ white balance calibration provides all this control over the colour temperature of our images, with only small losses in image quality, can we get away without filters altogether? No, not really. Although we can shift colour temperature in the conversion the more colours we invent in the computer the more we reduce our image quality. It is much better to get the colour temperature of the light as good as we can before it hits the sensor (using a filter) and then use white balance for fine tuning (either by calibrating in the water or in the computer). That said, if you have the wrong filter attached to your lens and mating whale sharks swim past - take the picture and worry about white balance later!

Lighting

Finally we can get on to some photography. Lighting available light shots underwater is very similar to lighting available light shots on land, and not at all like lighting normal wide angle underwater photography! Usually when we shoot wide angle underwater we shoot upwards to increase the contrast of the subject with the background. The subject is often then in silhouette, so we use



Filters let us shoot large subjects in colour that we could never light with flash. Nikon D100, Subal housing. 16mm lens. 40CC Red filter. 1/100th @ f6.7

flash to fill the shadow and provide light. We use aperture and flash power to control the flash exposure and balance it against the ambient light of the background which we control with aperture and shutter speed.

When taking available light filter shots the only light we have available to use is sunlight. It is therefore important that we position ourselves carefully to make the most of this light. In the same way as we would on land, we want this light coming over our shoulder and illuminating the scene we want to photograph. Shadows can be strong in tropical sunlight and large black areas in the images can look unsightly, so it is worth studying carefully how our subject is illuminated before deciding how to frame it. A slightly downward camera angle can help to reduce shadows, because sunlight usually comes down from above! Another tip is to shoot above white sand which is a good source of upwelled light to help fill any shadows. The final caveat is to remember

to check the viewfinder or LCD screen for our own shadow! With an ultra-wide lens and the sun behind us, this is an easy trap to fall into. I continue to ruin many shots by including my shadow!

As I explained above, in flash photography we control foreground and background exposures pretty much independently. Using only available light we cannot do this because we have only one light source. The best method I have found for controlling background exposures is to alter the camera angle. A downward angle picks up the dark blues of deep water that is invariably darker than your main subject, and an upward angle lightens the background giving a cyan/turquoise background.

The final lighting consideration is depth, because this is primarily a shallow water technique, that works best in the top 10 m. As we go deeper not only is more light scattered, but also the filtering effect of the water becomes stronger, which in turn, means we need a

stronger filter on the camera to remove all that blue. All this filter subtraction leaves very little light for photography! Digital cameras try to help by adding more red to the image, which works for a while but these digital lies will, sooner or later, ruin the shot.

Depth of the colour field

In my opinion the penetration of colour away from the camera in filter photography is its main advantage over flash photography. A filter image has good colours extending much further into the image than a flash lit shot. The reason for this becomes clear when we think about the relative light path lengths:

As an example (see Figure 2) think about photographing a small wreck in 5m of water. The camera is 0.5 m from the front of the wreck and 1.5 m from the bridge. With a filter the light path is 5.5 m for the bow and 6.5 m for the bridge. So the light path for the bridge is only 0.2 times longer than for the bow and should still show good colours. With flash the light path for colour is flash to subject and back to the camera. So for the bow it is 1 m and for the bridge it is 3 m. Therefore the light path is 3 times longer and little colour will be seen on the bridge.

This increased colour depth means that with filters we can take colour images we just could not get with flash. In addition to the creative potential this also makes filter photography an excellent survey tool for photographing large areas, even in low viz. We can exaggerate this effect further still if we chose subjects that slope upwards away from us. Looking again at the wreck in Figure 2 the bridge is actually shallower than the bow, which shortens the light path reducing the difference between light path lengths, If the subject matter slopes up at 45 degrees the colour will stay consistent until it reaches the surface because the light path will remain the same as the foreground (as camera to subject increases, so surface to subject decreases).

Conclusion

Filters allow us to cast off the excess baggage of flash photography. The pitfalls of flash photography have claimed many of my images that looked like winners through the viewfinder! Certainly it is an attractive prospect to be free of the problems of TTL, flash aiming, backscatter,



Filters are also suitable for long exposures because colour remains constant throughout the exposure, unlike rear curtain flash techniques. This shot tries to capture the feeling of following a buddy around! Nikon D100, Subal housing. 16mm lens. 40CC Red filter. 1/4th @ f22

Guide Numbers, synch cords, synch speeds etc! But the real promise of this technique is the very different lighting that can be achieved in our shots, allowing the digital photographer to capture shots that we just could not get on a slide.

Alexander Mustard

Alex will be talking about some of the advantages of digital cameras for underwater photography at this year's

Visions in the Sea

Conference in London later this year.

For further details contact [Ocean Optics optics@oceanoptics.co.uk](mailto:optics@oceanoptics.co.uk)

