Back to Basics

Why is it different underwater?

There are two main differences - Physical and Optical and both of them are caused by the medium in which we decide to operate - WATER.

PHYSICAL DIFFERENCES

To take underwater photographs we have to make sure that both we and our cameras are able to operate underwater.

We put on a diving mask and air tanks to help us see and breathe underwater and our cameras and accessories must be redesigned to cope with the two main effects of water - moisture and pressure.

Waterproof camera designs

A normal land camera can be waterproofed by covering it in a waterproof material. This can be as simple as clingfilm where the material acts as a water barrier but results in a poor optical quality. An effective seal can be achieved by overlapping clingfim but this is a very basic and temporary form of moisture barrier.

Most modern materials such as plastic, aluminium and glass form an effective moisture barrier but where one joins the other or there are gaps, a waterproof housing must seal these gaps to keep moisture out.

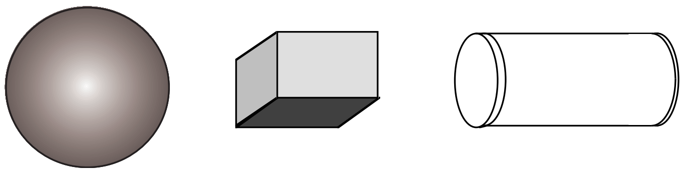
This is done either with a waterproof gasket or more commonly with O rings. These ingenious circular pieces of moulded rubber, when used in a sensible design, will stop moisture getting through a gap.

To use a camera in moist conditions you must either use a camera specifically designed for the purpose or put a normal camera in a moisture-proof housing to keep it dry.

Pressure-proof camera designs

As we go deeper underwater the weight of water above us exerts pressure on the camera which can either force water past moisture seals or crush the camera/housing.

The solution is to design the camera (or the housing) so that it can withstand the pressures which can be expected and still be able to operate the main controls. Most underwater cameras and housings are waterproof and pressure-proof to 50 metres which is commonly regarded as the safe maximum depth for sport diving. At this depth the water is exerting a pressure of 6BAR or about 88lbs per square inch!



Given the same wall thickness and same material, the ideal pressure vessel is a sphere, the poorest shape is a flat bulkhead. Somewhere between the two is a sensible compromise.

The most widely used design is based on a cylinder with flat ends whilst more sophisticated designs use moulded materials to contour the shape, keep the size to a minimum yet still retain good pressure characteristics.

O rings are used on circular shafts to allow controls to rotate and control the cameras functions.

Material considerations

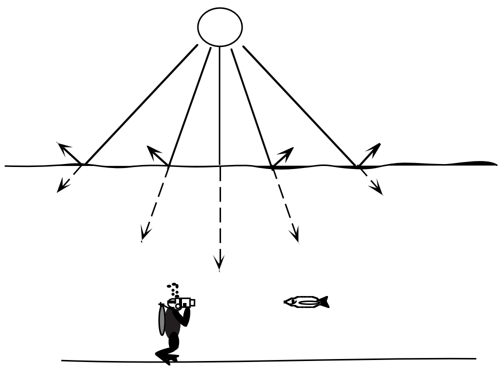
Saltwater is a highly corrosive medium if allowed to be and care should be taken to use materials which resist its corrosive powers. The most commonly used materials are plastic and aluminium with brass being used less and less.

Whilst these materials are fine on their own, care should be taken when combining metals i.e. where flash leads are screwed onto cameras. Some metals react with each other when in saltwater and a chemical reaction known as electrolysis takes place. Here the weaker of the two materials will corrode quite quickly - brass and aluminium are probably the worst enemies and should be kept apart wherever possible.

OPTICAL DIFFERENCES

Light absorbtion/reflection

Water is much denser than air and so light is absorbed much quicker than on land. In addition light is reflected back from the surface before it can get underwater so light levels are greatly reduced.



The solution is to dive as shallow as possible when the sun is at its highest and keep the distance from you to your subject to a minimum i.e. reduce the water path to a minimum.

Remember

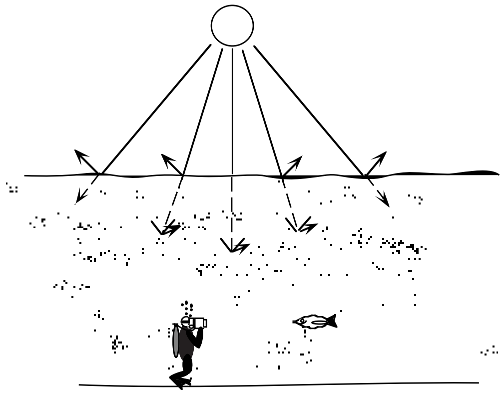
LIGHT PATH = DIVING DEPTH + CAMERA TO SUBJECT DISTANCE

If you need to go deeper, consider a faster film speed.

Suspended matter

Water can also hold matter in suspension which reduces water clarity and so limits our vision underwater and reduces contrast. In addition this suspended matter reduces the light from the surface by reflecting it back.

By far the most important effect is the reduction in visibility. It is worth bearing in mind that if visibility



on land were to be reduced to just 30 metres many activities would grind to a halt yet we would consider this to be excellent visibility.

Once again keep your water path to a minimum by using a wider angle lens and a slower speed film will give more contrasty results.

Colour absorbtion

Water acts as a strong colour filter and even the clearest water contains a heavy cyan (bluish) cast. The more water there is, the stronger the cast. Where there is algae in the water this will alter the colour cast from cyan/blue to green such as in UK waters.

Filters can counteract the cast to a limited extent. A filter in front of the lens of the opposite colour to the cast will help remove it but the deeper you go the stronger the filter will have to be.

Colour is expressed in UNITS OF STRENGTH and for every foot of light path 4 units of colour will be needed to eliminate the cast. Because a filter reduces the amount of light reaching the film, the exposure must be compensated. In general terms, for every 30 units of colour you will need to give one stop more exposure.

For example, you are in the Caribbean taking shots in 10 feet of water of a subject 5 feet away:

LIGHT PATH = 10 + 5 = 15

FILTER = 15 x 4 = 60

EXPOSURE COMPENSATION = 60/30 = 2 stops

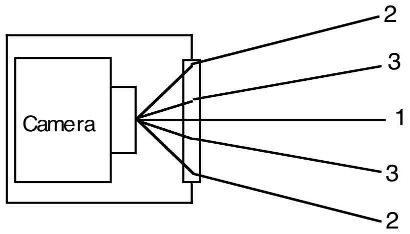
It doesn't take a genius to realise that filters have a limited effect in that the deeper you go the filter will have to be so strong that exposure times become impractical. However, if you need to photograph at depth (to photograph flourescing coral for example) filter accordingly and, if necessary, be prepared to use a tripod.

Fortunately modern digital cameras have circuits which can adjust colour balance but, in most situations, they still need additional filters to achieve the correct result.

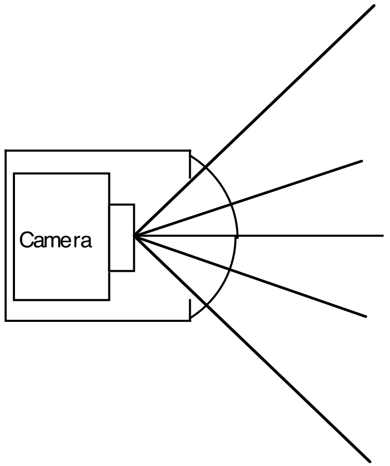
Refraction

Optically, water slows down light rays as they pass from air to water and vice versa. The effect of this is a deflection of the light path in certain circumstances and this will affect

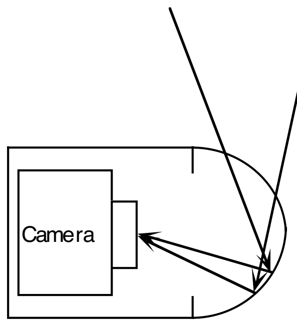
Refraction



The light rays are refracted (deflected) at the air/water interface.
The greater the angle of approach, the greater the refraction. Light rays (2) are refracted more than rays (3). Light ray (1) passes through the flat port at right angles so is not refracted, just slowed down



With a dome port, light rays are undeviated as they all pass the air/water interface at right angles. The result is a restoration of the angle of coverage of the lens



Dome ports are a simple and cost effective way of correcting most of the problems of refraction but can cause flare as light rays bounce from the inner surface of the dome and into the lens. This is internal reflection and becomes more of a problem the steeper the curve of the dome. The solution is to mask the surface of the dome not seen by the lens or use a lower profile dome

picture quality. This problem occurs when photographing behind a flat port but only becomes a real problem with wide angle lenses from 28mm and wider.

The simplest solution is to use an optical port such as a dome which attempts to keep the light waves at the air/water interface traveling in a straight line. This way, even though the light is slowed down it is not refracted. The dome is a simple and sometimes flawed method of correcting refraction and the ideal is to design a lens purely for use underwater. This is more expensive but will give better results (if the design is good!)

Peter Rowlands

peter@uwpmag.com