



Introducing Health Sciences: Visual Impairment

Lens Material

Commentary

Contamac is one of the country's leading contact lens material manufacturers and it's here that the chemical design process begins which will dictate the properties of the final product. But what they produce here looks nothing like a contact lens.

Int

John, we've got a lot of hard plastic disks here. I can't believe you make soft contact lenses out of these.

John

Well in truth we don't make the lenses ourselves, we are manufacturing the materials for the contact lens manufacturer to turn into a lens and yes, they do start as a hard piece of plastic but we build in the properties to these plastics so that once the lens is produced they will be soaked in saline solution at .9% and will swell to their final size and become a very soft material.

Int

So what kind of percentage water uptake do you get?

John

Generally soft lenses start at 38% water uptake and they go through a whole range up to 80%. Above 80% the structure of that polymer matrix is so weak that it will not support the lens structure.

Int

So what are the variables involved in polymer manufacture here?

John

Well in the first place we will vary the quantities and the types of monomers that we will use. We'll also vary the amount of cross-linker and for that matter the different types of cross-linkers, we'll vary catalyst levels, and certainly polymerisation times and temperatures.

Int

What monomers do you use in manufacturing these polymers?

John

We're using hydroxy-methylmethacrylate, vinylpyrrolidone, methyl methacrylate, several other cross-linking agents, catalysts, etcetera. A cross-linker has quite a significant effect on the finished blank, it gives us the rigidity, it gives us, it also affects swell factors as well.

Int

So when you've cross-linked the polymers, you end up with a mesh, a kind of a cage?

John

Yes, like a sponge, a matrix, and this matrix will absorb moisture, water and in this case, saline at .9%, and will expand to a given size and this, indeed, is a very critical aspect of the material. If we cannot produce a reproducible material that will expand to a known factor, then the contact lens manufacturer can't predict the sizes of lenses that he'll get from that plastic.

Int

What does the monomer determine in the end product and what are the characteristics?

John

It's always a trade-off. You can have comfort, you can have water uptake, you can have rigidity, you can have better machinability, wearability, and one monomer on its own will not determine those characteristics; it's a blend.

Commentary

The basic construction of a hydrogel involves using monomers and an initiator to create a polymer. Add to this mixture what's called a cross-linker and a three-dimensional network of joined polymer chains can be created into which water can be incorporated.

Each monomer has a double bond that can be opened up by an initiator, effectively supplying two free bonds. These can then bond to other monomer groups, so forming a polymer chain. Cross-linkers also have the same double bonds but at both ends of the molecule, so once these bonds are freed the cross-linker can be incorporated into a polymer chain.

This can happen at both ends of the cross-linker molecule, so linking two polymer chains together to form a sheet.

Cross-linkers can also link between sheets to create a three-dimensional cage-like structure into which water molecules can fit. This creates the hydrogel.

Different amounts of water can be trapped depending upon which combinations of monomers and cross-linkers are used.