

Air Optix Colors

Alcon's Dr Inma Pérez-Gómez, Jonathon Bench and Dr Dwight Akerman discuss how Air Optix Colors lenses are bringing together comfort, breathability and beauty like never before

THE ABILITY to change clothing according to mood and occasion has led to the existence of a substantial fashion industry with a large following. Colour contact lenses enable people to extend this flexibility of appearance to their eyes, making it possible to use lens colours that complement an outfit, or create a natural enhancement to the eyes' appearance. This fashion aspect of contact lenses could be regarded as an extension of the use of fashionable and colourful frames for optical correction by spectacles. The evolution of colour contact lenses has been varied and interesting.

Development

With PMMA and rigid gas permeable (RGP) contact lenses, a tint with about 5% absorption is commonly added to make the lenses more visible during handling, without the intent of changing eye colour. Higher absorption tints are used for colour/iris enhancement on lighter coloured eyes. As the tint is incorporated into the material, higher power contact lenses with a greater average thickness are more absorptive such that someone with anisometropia might end up with slightly different eye shades.

As soft lenses have larger diameters extending onto the sclera, adding colour to the material would result in a coloured ring on the white of the eye around the limbus. To address this, a coloured central button fused into a clear surround was proposed,¹ although this did not reach mainstream use, and subsequently dyes were applied to the central part of the lens, with the periphery masked off to prevent tinting. The further development of colour soft lenses has taken some more interesting turns.

In 1969, Professor Otto Wichterle

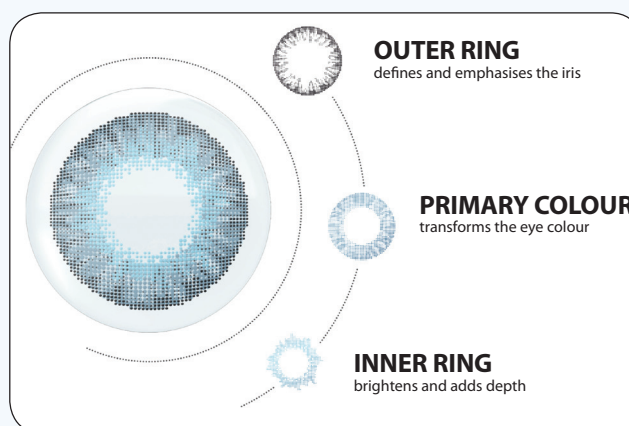


Figure 1 The beautiful 3-in-1 'color technology' of Air Optix Colors contact lenses

patented the idea of diffusing a coloured dye into a hydrogel from one surface, and a precipitant from the other surface, so that when they met an insoluble colour was precipitated in the middle of the lens matrix,^{2,3} or deposited between two polymer layers.³ Without such fixation, dyes infused into hydrogel lenses can diffuse

back out during wear or disinfection, with loss of the colour.⁴ Materials can be swelled to allow entry for larger dye molecules, and then contracted again to trap the colour in the material.⁴ To achieve colour fastness, reactive dyes can be attached covalently to the spine of the polymer chain, either with the dye first infused into the lens and then fixed,⁴ or by attaching it to the

surface of the lens.⁵ Previous attempts to attach colour to the lens surface were less successful, with the pigment rubbing off or flaking.⁵

Until this stage, the tints used had been translucent, and could enhance light-coloured eyes. The tint would filter some colour wavelengths from incident white

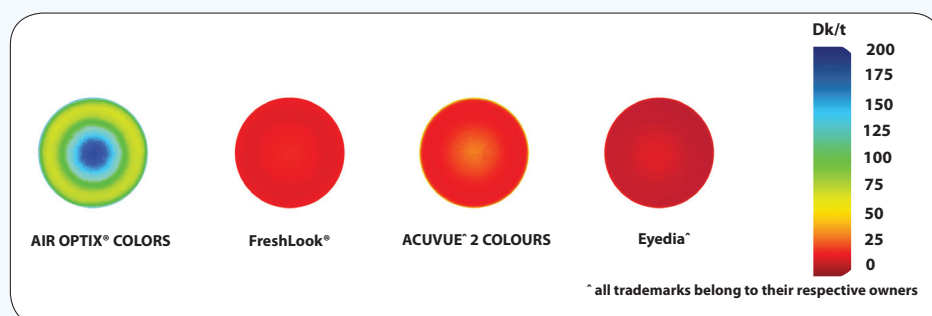


Figure 2 Oxygen transmissibility maps for colour contact lenses

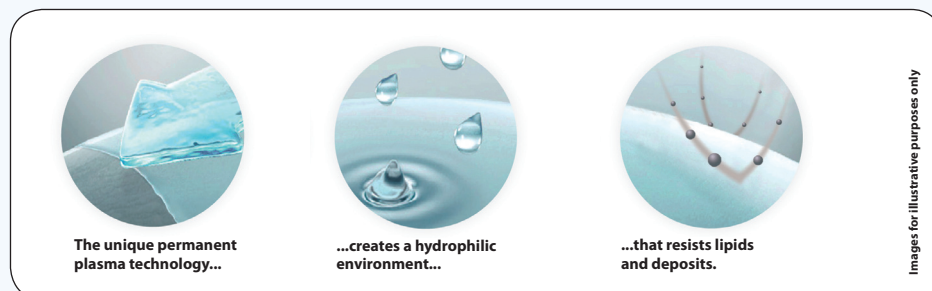


Figure 3 Lotrafilcon B: Unique permanent plasma surface technology for consistent comfort from day 1 to day 30.²⁰

light, resulting in a different spectrum being scattered back from light-coloured irides, changing their appearance. With brown irides, most of the incident light is absorbed, and so translucently tinted lenses look much the same as clear ones. To change the colour of brown eyes, a different effect is needed, and this is achieved by the use of opaque elements which conform to the dimensions of the underlying iris. Early processes to achieve this resulted in a completely opaque area of the lens over the iris.⁶ The effect of making the entire iris area opaque is to move the iris colour, which normally occurs at the back of the anterior chamber, to the corneal surface, resulting in an unnatural appearance. This strengthens the effect of lenses designed to dramatise, but it does not satisfy the requirement of wearers seeking a natural look, for which an appearance of depth has to be maintained.

One approach to this was an opaque pattern on the lens, such that the true iris is still partially visible through the tint, retaining the impression of depth,⁷ and another used an iris-patterned (again with gaps) light-coloured laminate within the lens, with a translucent tint on the anterior surface.⁸ Here, the laminate would appear as the colour of the overlying tint, and the iris behind it would show tinted in the normal way for that colour of eyes, so that

Subtle

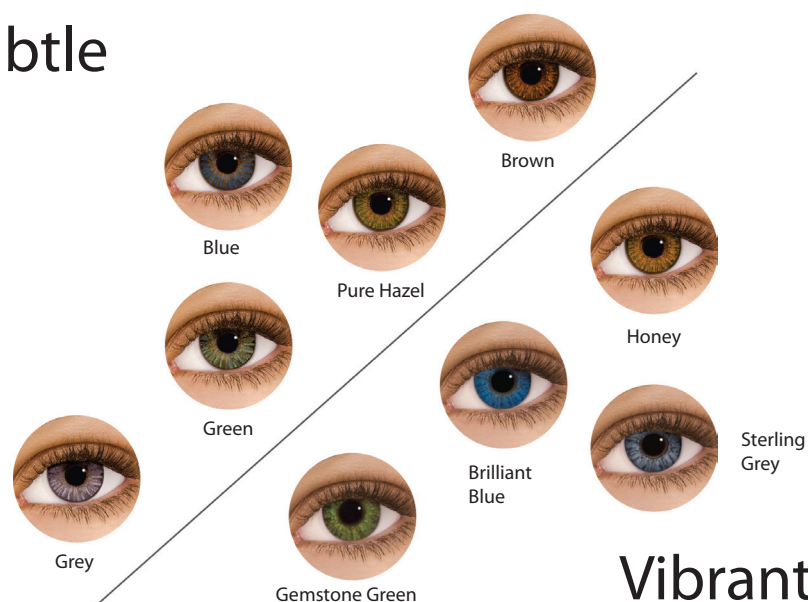


Figure 4 Colour range of Air Optix Colors

dark eyes would show the tinted laminate over the true iris colour. Technologies proposed to apply an opaque pattern included spraying⁹ and printing onto the lens surface¹⁰ or the mould before material polymerisation.^{11,12} To imitate the human iris, patterns have also moved from single colours to more complex ones, using peripupillary coronas and changing coloured patterns at different diameters towards the iris periphery (see Figure 1).^{13,14}

Other, more exotic ideas have included pearlescent lenses to highlight the eyes,¹⁵ and a dark limbal ring on an otherwise clear lens to make the eyes look bigger.¹⁶ This enhancement of the limbal ring is a

feature of 3-in-1 technology illustrated above – limbal definition fades naturally with time, and its enhancement adds a more youthful look. Careful consideration of this limbal ring design also allows us to aesthetically improve the perceived beauty of the eye.

Oxygen matters

Parallel to the evolution of colour contact lenses there have also been strides in the development of materials, most significantly with the arrival of silicone hydrogels which allow higher amounts of oxygen through the contact lens. The contact lens oxygen transmissibility (Dk/t) required for no contact lens induced corneal oedema in open-eye and closed-eye conditions is estimated at 35×10^{-9} and 125×10^{-9} respectively.¹⁷ Dk/t values will vary with thickness across the diameter of the lens because of its optical power (see Figure 2). Silicone hydrogel materials achieve the daily wear criterion offering a more breathable option for all patients, and peace of mind to eye care professionals.

Consistent comfort

The inclusion of hydrophobic silicone in materials improves oxygen permeability dramatically, but tends to make them more prone to organic deposits picked up from the tears and environment, particularly lipids which can affect

AIR OPTIX® COLORS product information	
Material	lotrafilcon B
Water content	33%
Oxygen permeability	110 ¹
Oxygen transmissibility (Dk/t)	1382 at -3.00D
Surface	Permanent plasma technology
Base curve	8.6mm
Diameter	14.2mm
Powers (D)	6.00 to -6.00D (0.25 steps) -6.50 to -8.00D (0.50 steps)
Center thickness (-3.00D)	0.08mm
'Colors' (encapsulated in lens)	Blue, brown, grey, green, pure hazel, brilliant blue, gemstone green, honey, sterling grey
Recommended wearing schedule	Daily wear
Recommended replacement	Monthly
1. $\times 10^{-11}$ (cm ² /sec)(mLO ₂ /ml x mmHg) 2. $\times 10^{-9}$ (cm/sec)(mLO ₂ /ml x mmHg)	

Table 1 Air Optix Colors breathable* contact lenses product information

lens wettability, comfort and vision. This tendency is counteracted by the inclusion of wetting agents into the materials, or by the modification of the lens surface to make it more stable and hydrophilic. A number of silicone hydrogel contact lenses use different strategies to achieve wettability.¹⁸ Only lotrafilcon B (Air Optix brand contact lenses) is designed with a unique permanent plasma surface technology that smoothes and protects the lens to retain moisture and resist deposits.

New Air Optix Colors breathable* contact lenses combine beautiful colour with high-Dk/t silicone hydrogel material for white, healthy-looking eyes, and an ultra-smooth plasma surface technology for comfortable lens wear. Available in nine natural-looking colours; five subtle and four vibrant (see Figure 4), Air Optix Colors is a natural add-on to Air Optix Aqua contact lenses.

Inner beauty, outer comfort

Unlike other colour contact lenses with colour printed on the lens surface, the colour of new Air Optix Colors breathable* contact lenses is encapsulated within the silicone hydrogel material.¹⁹ With colour inside, all that touches patients' eyes is the ultra-smooth permanent plasma surface of Air Optix brand contact lenses. Finally, consumers can enjoy beautiful, comfortable lens wear.

The first colour silicone hydrogel contact lens sets a new standard. New Air Optix Colors delivers comfort, breathability* and beauty because only Air Optix brand contact lenses are designed with a unique permanent plasma surface technology that smoothes and protects the lens to retain moisture and resist deposits,²¹ provides six-times more oxygen than that of the leading colour contact lens²² for white, healthy-looking eyes and utilises the 3-in-1 colour technology of FreshLook colour contact lenses for naturally beautiful eye colour.

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22. Based on the ratio of lens oxygen transmissibilities; Alcon data on file, 2013.

*Dk/t = 138 @-3.00D. Other factors may impact eye health

Important information for Air Optix Colors (lotrafilcon B) contact lenses: For daily wear only for near/far-sightedness. Contact lenses, even if worn for cosmetic reasons, are prescription medical devices that must only be worn under the prescription, direction and supervision of an eye care professional. Serious eye health problems may occur as a result of sharing contact lenses. Although rare, serious eye problems can develop while wearing contact lenses. Side effects like discomfort, mild burning or stinging may occur. To help avoid these problems, patients must follow the wear and replacement schedule and the lens care instructions provided by their eye doctor.