SMART COLOURS

TEP
TECHNOLOGY ENHANCEMENT PROGRAMME

20°C 30°C 40°C 50°C 60°C 70°C 80°C 90°C

Kettles that change colour and signs that glow-in-the-dark are two recent examples of products becoming 'smarter' as a result of new materials. Colour-changing thermochromic pigments are now routinely made as inks for paper and fabrics - and incorporated into injection moulded plastics. A new type of phosphorescent pigment, capable of emitting light for up to 10 hours, has opened up entirely new design opportunities for instrumentation, low-level lighting systems etc.

Unfortunately, the materials offering these new exciting properties have been both difficult to obtain and problematic to use in one-off prototyping. The *Smart Colours* system now solves both problems by enabling the complex pigments to be combined with ordinary acrylic paint as the base (or carrier) medium. In other words, you can now create and mix up your own thermochromic or glow-in-the dark materials!

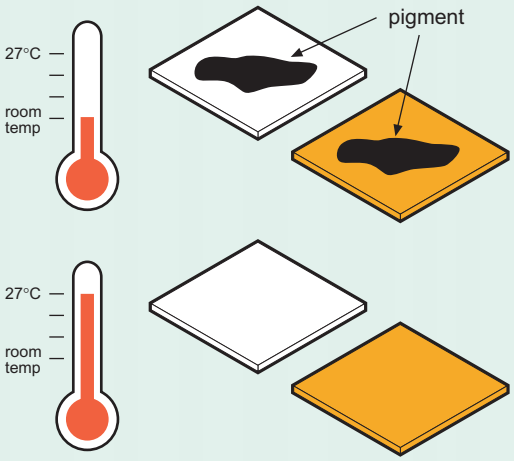
THERMOCHROMIC PIGMENTS

Thermochromic materials change colour at specific temperatures. Typically, they are incorporated into a special ink and printed onto plastic films to create thermometers or temperature indicators. The battery test strip is a good example. If the battery is in good condition, current flows through a printed resistor under the thermochromic film and heats it to cause a colour change.

Most thermochromic materials are based on liquid crystal technology. At specific temperatures the liquid crystals re-orientate to produce an apparent change of colour. The liquid crystal material itself is micro-encapsulated - i.e., contained within microscopic spherical capsules typically just 10 microns in diameter. Billions of these capsules are mixed with a suitable base to make thermochromic printing ink or, for example, with plastics destined for injection moulding.

The thermochromic pigment in the ***Smart Colours*** system is made up as a liquid paste compatible with any acrylic media. It is available in four colours plus black:

The Principle...
At normal room temperature the pigment appears coloured, but at 27°C the colour disappears. For example, if black thermochromic pigment is applied to a white surface, the surface turns from black to white at the change-over temperature. Similarly, if the pigment is applied to something orange the surface colour changes from black to orange at 27°C. When the temperature falls, the pigment colouring re-appears.

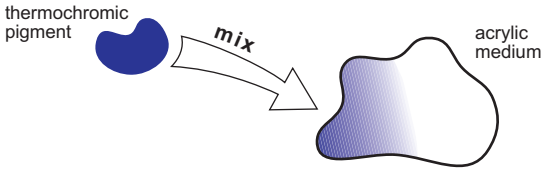


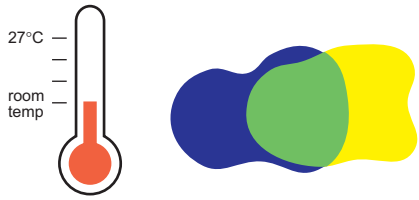
Golden orange | Blue | Black | Magenta | Brilliant green

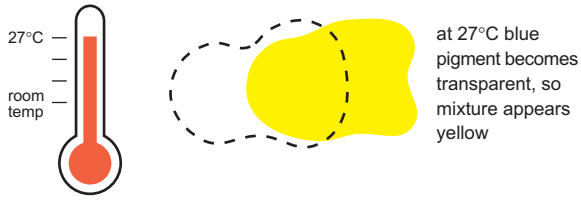
THERMOCHROMIC PIGMENTS

The base or carrier supplied for the ***Smart Colours*** pigments is an acrylic medium that is particularly suitable for application to paper, plastics *and fabrics*. However, the pigments can also be mixed with practically any acrylic paint. Trial and error will determine the proportions of the mixture.

The creative opportunities really begin when the pigments are mixed with acrylic paints of different colours. For example, if blue pigment is mixed with yellow acrylic paint, the resulting colour is green. But at 27°C, the blue hue disappears and the green changes to yellow! There are, of course, an infinite number of possible colour variations.







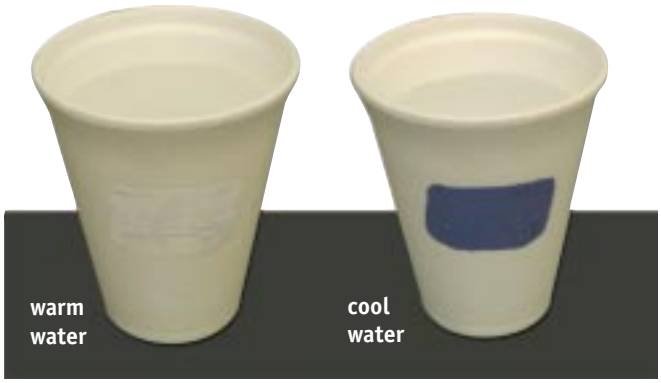
IMPORTANT POINTS TO REMEMBER:

- If **painting or printing onto fabrics use only the acrylic medium** supplied within the system. This is ideal for screen printing as well as hand painting or stencilling.
- Use only the minimal amount of pigment for the desired colour.
- Dilute the acrylic carrier with water if necessary - but keep mixing periodically to prevent separation of pigment and acrylic.
- Take all normal precautions when using chemicals. Handle in accordance with good industrial hygiene and safety practice - e.g., use in a well ventilated area and wear disposable gloves.

USING THE THERMOCHROMIC PIGMENT:

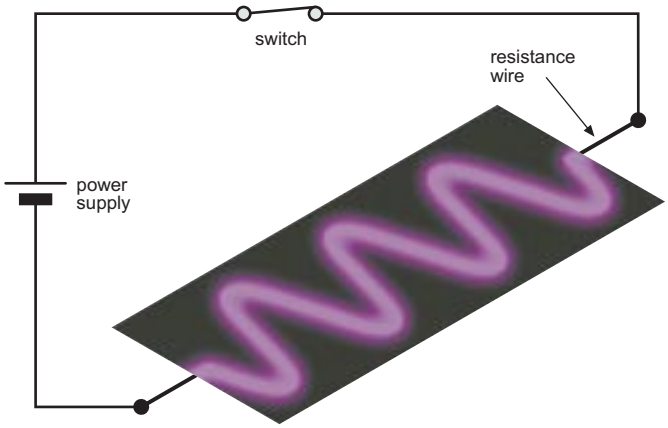
Its a good idea to begin by creating a test/demonstration strip on paper or plastic sheet (e.g. a thin walled plastic cup). Mix a small amount of pigment into the acrylic base and dilute with water, if necessary, so it can be applied with a small paint brush. The painted surface should be left to dry in a warm place, where the colour-change effect will become apparent even before drying is complete.

If your samples are painted onto a thin walled plastic cup which is then filled alternately with hot and cold water, the colour change is immediate and dramatic.



APPLICATIONS

The ***Smart Colours*** range of pigments are formulated for a colour change at near body heat (which makes them ideal for garments that change colour when worn or touched). In general, the pigments can be used for any application where a temperature warning is needed, e.g., drinking cup, hot surface warning, food storage. The illustration shows a visual display idea based on the use of resistance wire behind a sheet of purple coloured paper covered with black thermochromic pigment. Where the wire heats up the pigment, the purple starts to show through. This principle can be used to create a messge display or, for example, a battery or fuse tester.



PHOSPHORESCENT PIGMENT

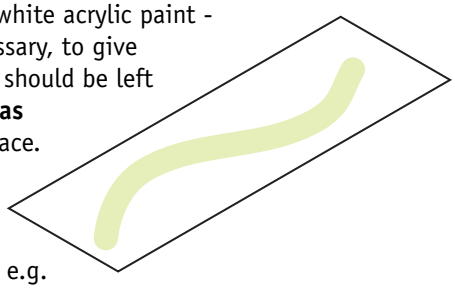
This pigment, available in (abrasive) powder form, was originally developed as a substitute for both the radioactive and older phosphorescents used to make glow-in-the-dark clock and watch hands. It absorbs and stores sufficient energy to give an afterglow lasting up to ten times longer than zinc sulphide phosphorescents. After exposure to natural or artificial light, it will glow practically all night.

The pigment should NOT be exposed to moisture for any length of time, but it can be mixed and applied with the acrylic base or white acrylic paint. This can be diluted with water providing that the drying out takes place quickly. When the acrylic hardens, it effectively locks the pigment into a water-resistant film.

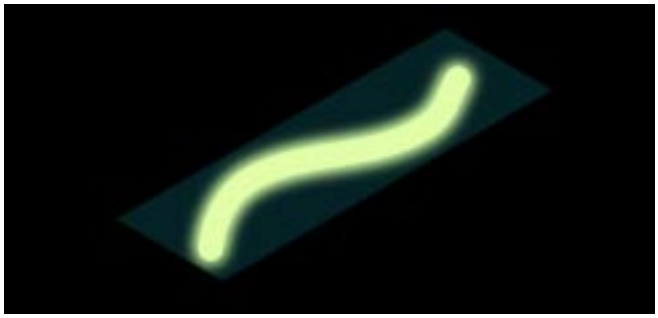
The effectiveness of the pigment depends (a) on the proportion mixed into the acrylic and (b) the thickness of film applied. These are both subject to trial and error, but it should be noted that **the pigment is highly concentrated and only very small amounts are needed to produce glow-in-the-dark effects**.

USING THE PHOSPHORESCENT PIGMENT

Again, it is a good idea to create a test strip using paper or plastic sheet. Try mixing different quantities of pigment into either acrylic base or white acrylic paint - adding water, as necessary, to give fluidity. The test strip should be left to dry out **as quickly as possible** in a warm place.



When dry, expose the strip to daylight or a bright artificial light - e.g. a torch beam - and then examine the strip in a dark place. If exposed to light for at least 30 mins, the material should continue to give a significant afterglow for up to 8 hours. It is particularly responsive to UV - hence the use of UV light to display glow-in-the-dark objects in shops.



IMPORTANT POINTS TO REMEMBER:

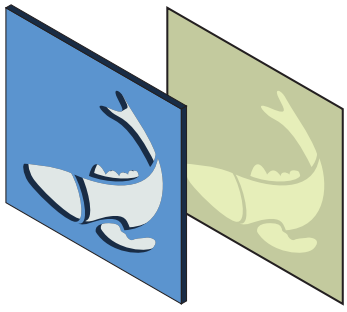
- Keep the pigment dry and stored away from moisture.
- Use the minimum amount of the pigment to achieve the desired effect.
- Dilute the acrylic media with water if necessary - but **use immediately and then dry quickly.**
- Take all normal precautions when using chemicals. Handle in accordance with good industrial hygiene and safety practice - e.g., use a nose mask and wear disposable gloves.

APPLICATIONS

Although the pigment was developed for clock and watch hands, it has rapidly found a host of other uses - as evidenced by the variety of glow-in-the dark objects found in shops. Current uses include:

- *Traffic signs*
- *Instruments and controls*
- *Emergency signs*
- *Home appliances*
- *Path marking*
- *Printing inks*
- *Fire fighting equipment*
- *Novelty decorations*

It is particularly effective for night-time illumination and provides a distinct visible light in conditions of absolute darkness. Paper or other film coated with the pigment will act as a temporary photographic plate if exposed to light through a mask - or even a photographic negative. This suggests some recreational applications, but there are many more serious uses waiting to be uncovered.



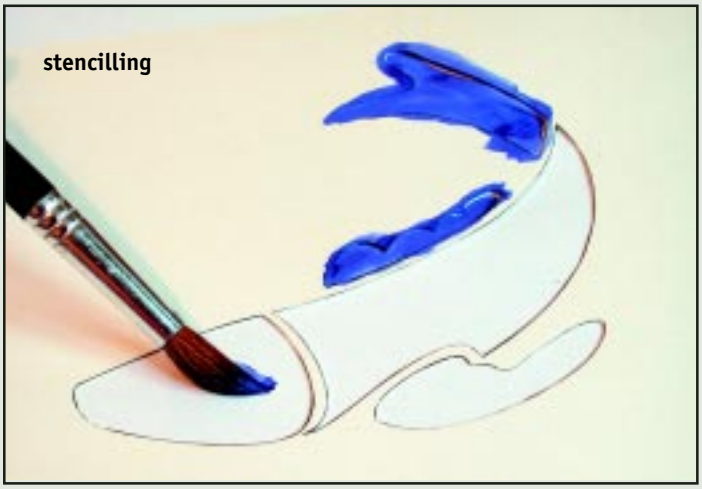
phosphorescent pigment exposed to light through mask

PHOSPHORESCENT PIGMENTS

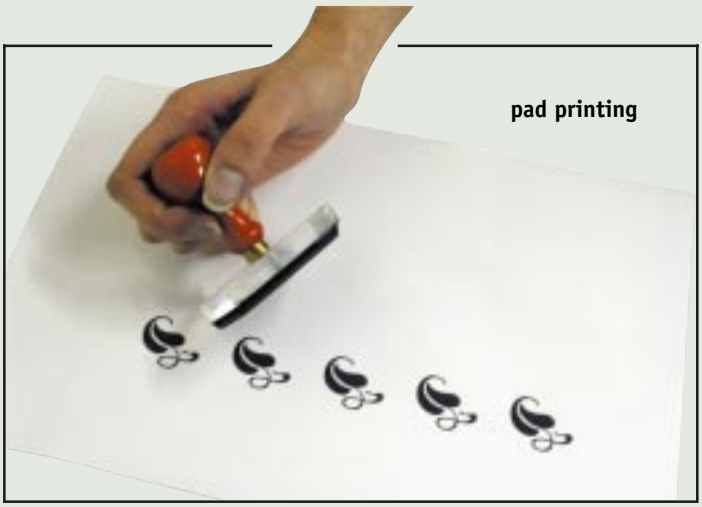
SMART COLOURS APPLICATION TECHNIQUES

Since both thermochromic and phosphorescent pigments are mixed with acrylic, it is possible to adjust the viscosity of this base by dilution with water to suit the method of application. A relatively thin mix can be applied with a paint brush and a thicker paste by pad or screen printing. Application methods include:

- *Screen printing*
- *Painting with a brush*
- *Stippling/stencilling with a brush*
- *Pad printing - e.g. with a lino-cut or rubber stamp*
- *Rubber roller*



stencilling



pad printing

FURTHER INFORMATION

For supplies of the ***Smart Colours*** system and other smart materials, please contact:

Teaching Resources,
Middlesex University,
Trent Park,
Bramley Road,
Oakwood,
LONDON
N14 4YZ

Tel: 020 8447 0342
Fax: 020 8447 0340

MIDDLESEX UNIVERSITY

SMART COLOURS MATERIALS

Please note that the pigments are highly concentrated and are therefore supplied in relatively small quantities to make them more affordable.

SMART COLOURS STARTER PACK

This pack contains 1 ml of each thermochromic pigment paste; 1 gram of highly concentrated glow-in-the-dark pigment powder; and a 20 ml syringe of acrylic medium.

Stock no: IT9 010 **Cost:** £3.50

ACRYLIC PAINT (75 ml tube)

Colour	Stock no.	Cost (£)
Yellow	GD1 019	1.65
Red	GD1 020	1.65

THERMOCHROMIC PIGMENTS

Colour	Stock no.	Cost (£)
Golden orange (5ml)	IT9 003	1.05
Blue (5ml)	IT9 004	1.05
Black (5ml)	IT9 005	1.05
Magenta (5ml)	IT9 006	1.05
Brilliant green (5ml)	IT9 007	1.05

ACRYLIC BASE - 400 ml

Stock no: IT9 011 Cost: £2.30

GLOW-IN-THE-DARK PIGMENT (5 grams)

Stock no: IT9 009 Cost: £2.95

Note: Datasheets for thermocolour and phosphorescent pigments are available on request.