

ILFORD HOLOGRAPHIC CONSUMABLES
WORLD STRATEGY

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Abstract:

In 1985 ILFORD drew up design plans for the holographic films and chemicals that would be required to convert the craft of holography into an industry that would meet the needs of the consumer market. This paper describes how these plans have been modified to take into account the realities of the market situation, with special reference to the problem of changing from low volume, high price to high volume low price holograms while retaining quality."

Introduction

When ILFORD seriously entered the holographic field in 1985 the typical holographic company was essentially a mastering operation since it did not primarily concern itself with the production of copies. The major activities of such companies consisted of:

1. Image concept
2. The production of any models or artwork necessary to realise the image concept
3. Production of an H1 laser transmission master

4. The production of an H2 white light reflection or white light transmission hologram

Apart from the skills necessary to manipulate lasers and basic optics, the only ancilliary technologies employed were:

5. Dish processing
6. Painting the backs of reflection holograms with black paint
7. Some picture framing

In commercial terms, the principal features of such a traditional holographic company were, and still are:

1. Very small consumption of holographic materials by the standards of the suppliers i.e. thousands of square meters instead of millions of square meters.
2. Glass plates used in preference to film
3. A great diversity of 'secret' processing chemistries which were frequently unstable and usually poisonous. They led to non - reproduceable results and therefore high wastage factors.
4. A highly labour intensive production resulting in only a few holograms per week of commercial quality
5. The holograms produced were very expensive and therefore only available to the select few.
6. A very low exploitation of the potential markets for display holograms
7. A questionable economic viability for everyone involved in the process from the producers of holographic consumables through to the distributors of the end products.

One frequently hears the comment in the holographic community that 'no one makes a profit out of holography'. In fact it seems to be the lot of holographic companies that they do it almost as a labour of love, the reward coming principally from the satisfaction of the realisation of the original image concept. When that has been completed the job satisfaction is low in the production of copies.

It was ILFORD's belief that this scenario would rapidly change in favour of the commercial exploitation of holography by the rapid development of copying techniques. Surprisingly, several years on, Applied Holographics PLC, based in England and the USA, is still the only significant company involved in the copying of silver halide holograms. This seems to be for a variety of reasons.

Firstly, holographers are not profit orientated. Secondly they do not have either the inclination or necessary skills to build copying cameras and thirdly they are possibly not convinced of the need for high volume low cost holograms.

Although ILFORD prepared itself well for the copying revolution to take place by provision of suitable materials, it has still not happened and it is worth examining here what new skills must be acquired by individual companies in order to bring it about.

Contact Copying

Firstly for the copying of reflection holograms by contact copying (which is the simplest technique) skills must be developed in the production of reflection masters which have the characteristics of high reflectivity at the wavelength of the copying laser and stability to light and humidity changes. Secondly a copy camera is required which should be based on a scanning He-Ne laser technique in which a narrow line is swept across the master in contact with the copy film. This technique has the benefit of using an inexpensive laser of relatively low power in such a way that the problems of vibration and settling time are minimised.

Details of this technique are given in the paper by Holicon USA in this symposium and so will not be further described here. Thirdly some degree of controlled processing, preferably machine processing must be developed in which good control of the temperature of the processing chemicals is maintained. The time in each chemical bath must also be controlled together with a chemical management system to ensure constant concentrations of the active chemical constituents. Finally an air dryer is essential because it is faster, more reproducible and leaves the gelatin in a state less susceptible to subsequent colour change.

Lamination

The painting of black backings onto holograms is a technology rather like the dying branch of a tree - it goes nowhere. The acquisition of a simple, even hand operated, laminator opens up a whole variety of possibilities for the attachment of single sided black laminate to the back of reflection holograms, attachment of a double sided laminated for the production of stickers, the use of a clear laminate to mount transmission holograms onto glass or plastic; or even to mount large format film to glass prior to exposure. Even mirrored laminates can be applied to the backs of white light transmission holograms so that they can be more conveniently viewed by reflection.

As well as opening up many possibilities for the manufacture of products with holograms incorporated, lamination has the virtue of being a well established technology with a whole variety of laminates, laminators and expertise to call upon. It is also clean and quick to use giving reproducible results. The only caution that must be exercised is that it must be done in a clean environment in order to avoid the inclusion of dust and fibres which cheapen the appearance of the final image.

ILFORD SP673T Red Sensitive Holographic Film

It has often been said that this film either does not work or is very slow or is not truly compatible with the He-Ne laser. It is true that in the traditional mastering technique whereby the beam is spread over a large area, this emulsion appears to be slow, but as explained above, this material was designed for the copying revolution which is still suffering, birth pangs. It was designed with three important features which were considered crucial to the success of copying techniques.

Firstly its maximum sensitivity was to exposure times below one second, and preferably below one millisecond, since no one would seriously consider volume production with exposure times greater than one second because of the problems of vibration isolation. Secondly it was designed with a shrink factor known as the BIPS factor (BUILT IN PRE SWELL), since the technique of preswelling the emulsion prior to exposure in order to give a gold coloured hologram was obviously unsatisfactory in a commercial copying scenario. Given an exposure at 633nm followed by a process involving a non tanning developer and a rehalogenating bleach the emulsion will automatically shrink to give a yellow/gold hologram without the need for a triethanolamine pretreatment.

It is worth pointing out, that if for any reason, this shrinkage is not required, a quick 30 second wash of the film in water will remove the shrink factor thus giving wavelength retention rather than the bathochromic shift.

Experience shows that many holograms pretreated with TEA to produce shifting and extra sensitivity do not have colour stability and the colour will, over a period of time, change from gold to green. The ILFORD technology used to manufacture SP673T avoids the use of TEA and therefore produces bright, gold reflection holograms which are colour stable.

Finally the sheet film was manufactured using an optically inactive substrate in order to avoid the problems of birefringence associated with polyester base.

Lighting of reflection holograms

An important development which must take place and fortunately is taking place, is the greater consideration that must be given to the lighting of holograms to make them more commercially acceptable. In general terms a hologram smaller than 4 x 5" should not require any special lighting. It should be bright and shallow enough to be tolerant of ambient lighting. An 8 x 10" hologram however, will almost always require an auxiliary lamp but this can be incorporated into a desk top frame such as that marketed by Light Fantastic of London England. This viewer, although excellent in concept, suffers slightly because the light is a fraction too dim. Up to 12 x 16" requires something larger more like a wall mounted frame and anything up to 20 x 24" requires a light which cannot be incorporated into the frame owing to the distances involved.

The whole point here is that the overwhelming majority of potential and actual customers for display holograms cannot be expected to buy a light for themselves and experiment with angles and distances to optimise the image appearance. They will certainly not be prepared to do this when the price of the hologram is commensurate with the price of the lamp and its installation.

The expectation is that a complete unit can be simply purchased and plugged in so the features of integral lighting are that it should be:

- a) low cost
- b) free of installation difficulties
- c) standardised so that all holographers can make holograms to be used in the device
- d) readily available

Some lamps can be purchased today but they are expensive and hard to find.

ILFORD SP672T BLUE GREEN SENSITIVE FILM

It was obvious that the principal use of Argon lasers was with the 514nm line, mostly for large format work, and to some extent the blue lines were used, mainly for transferring from halide into photoresist. It was therefore clear that any emulsion which was truly compatible with such a laser should have high photographic sensitivity combined with low laser scatter since scatter is particularly apparent in the blue spectral region.

Clearly there is a large market for reflection holograms and to this extent Argon lasers are under utilised since they conventionally give green coloured holograms which have limited commercial acceptability. It is our belief that this laser is eminently suitable for the production of reflection holograms but there has to be some way of producing a yellow or gold reflection colour from it and in ILFORD's view this can be most reasonably achieved by a post process swelling bath which will permanently swell up the emulsion to a thickness greater than it had at the time of exposure.

This trick can be performed by using a solution of sorbitol in water but this causes streaky colouring and a sticky surface to the emulsion. Something better is therefore required which could be used in a processing machine on a replenishable basis.

Automated Processing

Automated processing is essential in any volume copying technique since it removes some of the major process variables in holography.

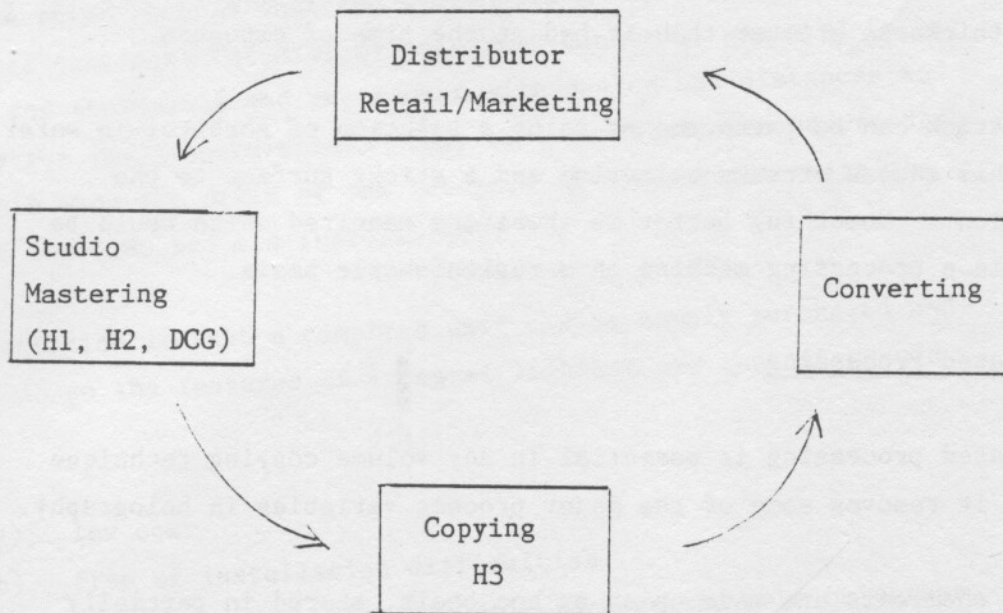
While chemicals are made up on an hoc basis, stored in partially filled bottles and used in dishes with the concentrations varying from one sheet to the next, highly variable results are to be expected together with high wastage factors.

Automated processing increases through-put, reduces labour costs and gives credibility to the holographic company tendering for orders in excess of a few hundred copies.

A natural evolution would be graduation from dish processing, which requires a capital outlay of, say, \$50 to some sort of desk top processor for sheet film costing say \$1000-10000 and finally, the Rolls Royce of processing machines for volume production which would be a floor standing processor with roll feed for continuous processing. This will cost \$25,000 - 40,000.

Alliances

Many holographers say that they have neither the time nor the inclination to invest in copying techniques or to research the lamination techniques etc. required to produce holographic products. This is understandable but immediately implies the need for alliances to be formed between companies in order to create the natural flow of orders in - satisfied customers out. Broadly speaking, the alliances are depicted in the diagram below.



Ultimately we would like to see the creation of many more retail outlets for holograms at the High Street level where holographic goods can be purchased almost on impulse. Such outlets will probably be stocked by distributors who can also act as order collection points from customers who have specific requirements. These requirements can be conveyed to the holographic studio which will convert the original ideas into a master which can then be transferred to a copying process which could be a different company.

The final stages required to convert the copies into goods, stickers, calculators, greeting cards etc. can also be carried out by companies who specialise in this type of work and they need know nothing about holography.

The distributor, who is key to the whole system, can also act as a marketing manager to promote the sales of holographic products. There is a good analogy here with the photographic industry where commercial photographers are usually the people who have direct contact with advertising companies and hence pick up the original commissions. They will also produce the artwork which is usually a negative or transparency but from this point onwards, the commercial photographer has no further direct involvement in the process. He will submit his 'masters' to another company who will produce the enlargements.

Ideal holographic company

We give here a checklist of activities which the successful holographic company must be involved in to ensure commercial success.

- Image concept
- Mastering
- Copying
- Hologram QA technology
- Finishing
- Lighting
- Packaging
- Product range
- Retail outlet
- R & D outlet
- R & D programme
- Marketing/Sales

Finally a sympathetic bank manager is an indispensable asset to convert the dreams of holography into commercial reality.