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# AGFA COLOUR

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BRITISH INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

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LONDON—H.M. STATIONERY OFFICE

# A G F A  C O L O U R.

Reported by

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## A G F A  C O L O U R - NEGATIVE POSITIVE PROCESS.

This process has been developed by the Agfa technicians during the War, and the latest German films were made with this material. To all intents and purposes, to the Producer it is a straightforward negative/positive process, using a single film for both negative or positive and an ordinary camera as operated under present Black & White conditions, it being advisable, however, to make sure of using the best colour-corrected lenses which have been coated by any of the latest processes. Augmentation of lighting is necessary, i.e., total in the neighbourhood of 400 foot candles. The Germans have employed mixed lighting in all their pictures, so it cannot as yet be determined which is the best medium. Very obviously, however, such lighting as exists in British Studios to-day would be perfectly adequate for the purposes of photographing in Agfa colour.

The broad principle of the method is as follows:-

In appearance the Agfa Colour Negative film is similar to any other film material, but it actually consists of three separate layers of colour-sensitized emulsion with a yellow filter interposed between the top and middle emulsions. Each one of these emulsions carries the usual silver bromide, but in addition there is added a colour component held in suspension in the silver bromide by a long string of fatty molecules. The top emulsion is sensitive only to blue, the middle to green and the bottom to red. Therefore, at the time of exposure the silver bromide is oxidized in exactly the same manner as in any ordinary emulsion, and should this film be developed in a normal developer, the result would be exactly as if it were an ordinary Black & White Negative film.

However, the Agfa technicians have discovered, after many years of research, the colour components which, in suspension in the silver bromide emulsion, would re-act correctly to one single solution which would develop the silver bromide and the colour components in one operation. In other words, at the points of exposure the silver bromide is reduced to metallic silver and at the same time and in the same places of exposure as the silver bromide, the colours are also produced, as the top layer, Yellow, the middle layer, Magenta, and the bottom layer Blue-green.

The process then follows to a bleach bath where the metallic silver is bleached out of the three layers so that the colours now only are left. The final fixing dissolves away the unexposed silver bromide and naturally the colour held in it, so leaving only a pure dye image in the three colours.

The thicknesses of the layers are as follows:-

| | |
|---|---|
| Blue Layer | 6 microns |
| Yellow Filter | 2 " |
| Green Layer | 6 " |
| Red Layer | 6 " |
| Film Base | 150 " |
| Anti-Halation Base | 1 micron |
| TOTAL: | 171 microns |

It is, of course, a Negative Colour -- in other words, the colours in the Negative are in juxtaposition to those photographed in actual fact. Blue would therefore be shown as yellow, green as magenta, and red as blue. In the printing it follows that these colours will again become as photographed in the original.

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The printing of a film can be carried out on any normal Printer that particularly makes use of a moving diaphragm, in that it may be found necessary to interpose light filters to obtain the best colour rendition in the final positive, but such a Printer as the Debrie which uses the moving diaphragm fibre band appears to be ideal, and is the machine that has been used by the Germans in all their Laboratories. The advantages of the process are manifold, in that it is a straightforward Negative/Positive process and by the interposition of filters any desired result can be obtained in colour correction. Even exposure has a great bearing on colour, and it should be remembered that printing can assist in obtaining night effects where ordinarily they really are not present in the Negative.

German Producers have informed me that they have found that their shooting time had decreased quite considerably, owing to the ease with which lighting can be carried out, it no longer being necessary to take infinite pains with shadow detail, but the question merely being to put on the required amount of light, the colour itself being the separating factor which, in Monochrome, must of necessity be carried out by light and shade. For what their statement is worth, they have told me that their schedules were cut down from fourteen weeks to nine weeks.

The Agfa process primarily depends upon the high technical excellence of the Stock Manufacturer, and it can be well understood that coating the film with three layers, plus a yellow filter layer, to infinitely fine limits, is no easy matter, but assuming then that the stock is of high technical quality and consistency, the problems of photography and lighting on the Floor are certainly no greater than in the case of Black & .hite. The responsibility of the Processing Laboratory, however, is considerably increased, and

great technical skill is necessary in producing consistently good material, though not nearly so difficult or complicated as such processes as Technicolor, Pantochrome, Dufay Colour, Kodachrome, etc. Almost any existing Developing Machine (with a few alterations) can be used; indeed the Developing Machines in Germany which were used for this process were all of the normal type and none had been specially built for the process. Careful Bath Control, however, is most essential, and it will be found that much replenishment and renewal of Developing Solutions will be required and great care taken in not permitting the developing solution to touch the skin, as it is of a poisonous nature. The Colour Developer is a hydroxy derivative of di-ethyl-paraphenylene-diamine.

The fullest possible information is available on the manufacture of Agfa Colour Film from Reports made by various Technical Officers immediately after the seizure of the Wolfen Plant belonging to Agfa, which is situated in the region of Leipzig. The principal technicians of the Agfa Company resident at Wolfen were cross-examined at length and these Reports are published by C.I.O.S. and B.I.O.S., and give the data of the emulsion manufacture, the manufacture of the colour components, the developers and any other solutions that were used in the Process. Many of these Reports are in the form of photostats of the actual documents as written out by the leading German technicians, which have been carefully checked against the confidential papers seized at the Plant, and conclusively point out that the information given was correct. A list of those available is shown in Appendix 'A'.

A G F A  C O L O U R.

The Patents of Agfa Colour being public domain and available to any who care to use them, I made a point of visiting the firm of Gevaert in Antwerp, and I was pleased to note that their Directors were preparing to go into manufacture of the Agfa colour material. I believe that they have been experimenting with a three-layer emulsion for some time, and the Patent situation was the only deterrent to proceeding further. These restrictions now being no longer applicable, and information being available as to how the process was actually carried out, I feel sure that the Gevaert Company will be in a position to manufacture this material satisfactorily. Whether they will be able to acquire the necessary chemicals for the process it is impossible to say, but no doubt they will get over this difficulty on a purely commercial basis.

It is hoped, therefore, that within a few months we should receive the first Test Rolls from Gevaert. I imagine we can expect quite a few problems to overcome, and no doubt the results will not be perfect at the outset, but with genuine application and co-operation between all the Technicians in the Industry, I feel sure that good results will finally be obtained.

A G F A  C O L O U R.

## TECHNICAL INFORMATION ON THE PROCESSING OF A G F A COLOUR NEGATIVE AND POSITIVE.

Agfa Colour Negative Processing is carried out in the following sequence:-

| | | |
|---|---|---|
| DEVELOPMENT | - | 6 minutes. |
| STOP BATH | - | 2 " |
| SPRAY WASH | - | 13 " |
| BLEACH | - | 4 " |

In the light:

| | | |
|---|---|---|
| WASH | - | 5 minutes |
| FIX | - | 5 " |
| FINAL WASH | - | 20 " |

Agfa Positive Processing in the following sequence, with Colour Sound Track:-

| | | |
|---|---|---|
| DEVELOPER | - | 10-11 minutes |
| STOP BATH | - | 2 " |
| SPRAY WASH | - | 15 " |

In the light:

| | | |
|---|---|---|
| BLEACH | - | 4-5 minutes |
| WASH | - | 5 " |
| FIX | - | 5 " |
| FINAL WASH | - | 20 " |

Developer Temperature Control: 18° C. ± 0.25° C.

## Agfa Positive Processing with Black & White Sound Track:

| | | |
|---|---|---|
| DEVELOPER | - | 10-11 minutes. |
| STOP | - | 2 minutes |
| SPRAY WASH | - | 15 " |

In the light:-

| | | |
|---|---|---|
| WEAK BLEACH | - | 3-5 minutes |
| WASH | - | 3-5 minutes |
| APPLICATION OF VISCOUS BLEACH | - | 3-5 minutes Bleach |
| (REMOVAL OF | - | 5 minutes Spray |
| ( VISCOUS BLEACH | | 5 " Fix |
| ( | | 20 " Wash |

Suction, or "blowing-off" method is recommended between:-

WASH AND BLEACH,
BLEACH AND WASH,
WASH AND FIX,
FIX AND FINAL WASH.

This bleaching process is carried out in such a manner that the Sound Track Area is not touched, leaving a Black & White Track. The application is carried out with a special type of applicator. The high viscous bleach on the picture renders it into fixable silver salt. The high viscous bleach is then removed by a special "stroking off" device and the film then goes into the Wash.

# F O R M U L A E.

## A G F A COLOUR NEGATIVE BATH.

### 'A'

| | | |
|---|---|---|
| 50 | litres | Water |
| 25 | grammes | M.19 in distilled water, |
| or 100 | " | M.19 in ordinary water. |
| 275 | " | Colour developer T.S.S. |

### 'B'

| | | |
|---|---|---|
| 50 | litres | Water |
| 25 | grammes | M.19 in distilled water |
| or 100 | " | M.19 in ordinary water |
| 7,500 | " | Potash T. Anhydrous |
| 50 | " | Sodium Sulphite T. Anhydrous |
| 250 | " | Potassium Bromide T. |

## NEW FORMULAE FOR BETTER KEEPING:

### 'A'

| | | |
|---|---|---|
| 50 | litres | Water |
| 100 | grammes | M.23 in distilled water. |
| 120 | " | S.55 |
| 275 | " | Colour Developer T.S.S. |

New Formulae for Better Keeping: (Cont.)

'B'

| | | |
|---|---|---|
| 50 | litres | Water |
| 100 | grammes | M.23 T. in distilled water. |
| 7,500 | " | Potash T. Sicc. |
| 200 | " | Sodium Sulphite Sicc. |
| 250 | " | Potassium bromid. T. |

BOOST.

'A'

| | | |
|---|---|---|
| 50 | litres | Water |
| 100 | grammes | M.23 in distilled water |
| 250 | " | S.55 |
| 400 | " | T.S.S. |

'B'

| | | |
|---|---|---|
| 50 | litres | Water |
| 100 | grammes | M.23 in distilled water |
| 7,500 | " | Potash T. Anhydrous. |
| 200 | " | Sodium Sulphite T., Anhydrous. |

Boost Rate: 15 c.c. per meter.

SYMBOLS: M.19 = Sodium Hexameta Phosphate.

M.23 = Ethylene diamine tetra acetic acid (water softener)

S.55 = Sodium Alkyl Naphthalene Sulfate (a wetting agent)

## A G F A  C O L O U R.

Colour Developer T.S.S. = Hydroxy derivative of (Biamioel A) di ethyl paraphenaline diamine:

$$H_2N - N\begin{matrix}-C_2H_5\\-C_2H_5\end{matrix}$$

Colour Developer: T-32 = p. - Oxyaethyl-aethyl-aminoanilin,

$$H_2N - N\begin{matrix}-C_2H_5\\-C_2H_4OH\end{matrix}$$

### FORMULA OF VISCOUS BLEACH.

| | | |
|---|---|---|
| 1,000 | c.c. | Water |
| 60 | grammes | Colorcoll* |
| 100 | " | Potassium ferri cyanide, |
| | or | |
| 1,000 | grammes | 10% ferri cyanide |
| 60 | " | Colorcoll |
| 5 | " | S.55 |

* Colorcoll -- Trade name for Tylose; a methyl cellulose = oxy methyl cellulose.

A G F A  C O L O U R.

## ORDINARY BLEACH.

| | | |
|---|---|---|
| 10 | litres | Water |
| 58 | grammes | Potassium phosphate, Grade 1. |
| 52 | " | Sodium phosphate. |
| 1,000 | " | Potassium ferri cyanide. |

THE STOP BATH should be kept to a pH value of between 4.5 and 5.0; it is made up of primary Potassium Phosphate.

FIXING is helped by adding Ammonium Chloride.

SOUND RECORDING requires special treatment, and while it is possible to avoid the special Viscous Bleach method and produce a blue-green track, the results as picked up by an ordinary photo electric cell are far from good, but in order to overcome this difficulty, all the latest German copies of Agfa Colour have been produced with this ordinary colour track, but all the Theatres in Germany were equipped with special blue-sensitive photo cells which had been developed by Zeiss Icon in Dresden, and by A.E.G. in Berlin. It is an Antimoni-caesium cell, which is equally good on Black & White type Sound Recording and Colour.

The VISCOUS BLEACH application method is considered a great nuisance, but was found to be the only way to procure Black & White Tracks which gave reasonably good sound reproduction.

## A G F A  C O L O U R.

The range of COLOUR FILTERS available for the printing of AGFA Colour Prints, is extensive; there are some twenty in each range of yellow, magenta and blue-green. By experience the grader can arrive at very fine limits of the correct colour filter to use to obtain any specific result, but at the outset each scene will have to be tested with various filters and light intensities to determine the best result. I imagine that some form of Cinex machine can be constructed where the various bands of filters can be inserted and quick exposures made and processed in a similar manner to Cinex strips, as used for grading in Black & White.

It is advisable to remember that care must be taken in drying temperature, and it should never be permitted to rise above 35°C. It should also be borne in mind that all the processes in the dark section should be carried out in complete darkness.

The Colour Developer is poisonous. Rubber gloves should be worn by all operatives in the Developing Room and convenient washing facilities with .1% Acetic Acid solution, clean water, and any good skin cream, should be near at hand. The chemists in Circulation Departments should also be protected in every way possible.

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## FILM PRODUCTION IN THE BRITISH ZONE OF GERMANY.

The possibility of Film Production in the British Zone, necessitating the use of adequately equipped Studios, is completely out of the question. There are no Studios at all in the British Zone, and therefore any Production plans for the immediate future would have to be confined to stories calling for the use of Exteriors and possibly such Interiors as could be photographed in existing large buildings, etc.

Some Lighting Equipment, suitable for work of the above nature, is available and can be gathered together from various sources. Portable Sound Equipment is also available, as are also a few Cameras of the Studio type, e.g. Debrie.

Personnel for the making of Feature Pictures, Documentaries, Newsreels, etc. are to be found in abundance, both in the area surrounding Hamburg and in the British sector of Berlin. This also applies to Actors of repute, although some of the most prominent are now black-listed as Nazis and cannot be used in any form of public entertainment.

Many stories are prevalent that Studios could be built or that existing premises could be used for the purposes of Film Production. These should be discounted, for not only are the suggested buildings not suitable for Film Production, not having any large covered areas, but, in most cases, are being used by the Military Government for valuable stores, and it is most unlikely that the Chief-of-Staff would hand them over to any form of commercial project.

The complete lack of Raw Stock prevents the Germans from going into production, and until such time as the Control Commission releases Raw Stock to them by importation from England, Belgium or Russia, the possibilities of any form of German-sponsored film production in the British Zone are negligible.

## DUBBING FACILITIES IN THE BRITISH ZONE.

At this moment dubbing facilities are available at the Mars Laboratory at SPANDAU, Berlin. Here they have installed a Klangfilm Tobis System of the latest type, with four Mixing positions and very good projection equipped with loop-running magazines. They also have excellent facilities for Editing and Cutting, plus what is at present a small Plant for Developing and Printing. This Plant, however, is being augmented with additional Machinery which will eventually make the Laboratory a very valuable asset in the British Zone. The Mars Laboratory is part of the UFA Organisation and comes under the main "umbrella" Company.

An independent Dubbing Theatre is being constructed and installed by the ex-Chief Sound Engineer of the UFA Studios -- Bruno Jensens. This man is taking the responsibility entirely as a personal matter as to whether he will get any work or not, and is installing his Equipment at AHLSTEDT, a suburb of Hamburg. He is proposing to put in Klangfilm Tobis Equipment, with a Four-way Mixing capacity. There is, however, the one major difficulty regarding any such installation at Hamburg, in that there is no Laboratory in the vicinity, but Jensens is endeavouring to put up a small Laboratory at the same time.

Another Dubbing Theatre is being constructed and installed at VLOTOH, but no full information is available as to the exact type of machinery that is going to be used, either regarding the Sound System or the number of mixing positions.

The two latter situations are therefore of a nebulous nature. Quite definitely, however, dubbing can commence immediately at the Mars Laboratory in Berlin where all facilities are available to commence

## DUBBING FACILITIES. (Cont.)

work. The Mars Laboratory have their own Sound Engineer and Sound Crew, but that is as far as their facilities carry. They are not in a position to undertake the work of phonetic translation, dialogue direction in dubbing, cutting and editing and final Sound Track mounting, and a special group of people would have to be employed to carry out these functions.

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## CONVERSATION WITH BRUNO JENSENS, EX-CHIEF SOUND ENGINEER, U F A STUDIOS.

Mr. Jensens reports that no improvements were made on Sound Equipment during the War, but extensive experiments were being carried out in Push-Pull which proved fairly successful on the Klangfilm Tobis method. He knows nothing whatever of Cross-Modulation or Inter-Modulation testing. Very little progress was made with microphones, and he was very emphatic that Klangfilm was not as good as the results obtained from the Western Electric installation at the Rome Studios with which he had contact and which he visited several times during the War.

Mr. Jensens spoke of the new play-back machine which employs an Ironised tape. This is a polyviny-chloride base ribbon, specially prepared and sprayed

CONVERSATION WITH BRUNO JENSENS (Cont.)

with oxide of iron and magnetised in passing a polarised magnet. He told me that several of these machines were at RADIO HAMBURG, and I took the opportunity of inspecting them. The advantages of these are that the ribbon can be cut and edited and joined similarly to any other film and has the capacity of being played back, without any background noise, eight or nine hundred times. The tape can be de-magnetised at will and used again.

In my opinion, the machine would be of inestimable value for play-back and wild track recording in the Studio, and would not only give infinitely better quality, but would effect a great saving of money and time.

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## AGFA COLOUR NEGATIVE - PAPER PROCESS.

The Agfa people have perfected a Colour Paper which works in exactly the same way as the Positive used in the film and is so simple to use that any amateur can Contact Print or Enlarge and Develop in his own bathroom. The Negative carries the same coating as the Cine Negative and can also be processed in a single solution plus a bleach and fixing bath. The results from this paper are remarkably good and could be purchased in any of the sizes that are normally obtainable in Bromide Papers.

It is gratifying to note that the paper was manufactured (and still can be manufactured if necessary) at the I.G. Farbenindustrie Plant at Leverkusen, Near Dusseldorf.

On my visit to this Plant, I was able to make enlargements from a Leica Agfa Colour Negative to 10 x 8 and develop these myself, with very good results and with no difficulty. Naturally, the paper is of no use without the Negative, but if we had Negative material available in this Country, the potential value of this process for amateur purposes is beyond conception. Its simplicity and ease in processing makes it possible for any amateur to undertake this himself at home, and would surely wipe out completely Black & White amateur photography.

APPENDIX 'A'.

## CIOS AND BIOS REPORTS ON AGFA COLOUR FILM.

| REPORT No. | DATE. | AUTHOR. |
|---|---|---|
| XXVI-61 CIOS | June, 1945. | Commander P.M. Chancellor. |
| XXX-15 BIOS | May/June, 1945. | Sq./Ldr. G. C. Brock. |
| XXX-17 CIOS | | Lt./Col. R. H. Ranger. |

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