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06379

Distr.
LIMITED

ID/WG.205/4
5 May 1975

ORIGINAL: English

United Nations Industrial Development Organization

Expert Group Meeting on New Techniques
in Wet-Processing of Textiles

Manchester, United Kingdom, 23.- 26 June 1975

PRACTICAL ASPECTS OF DYEING AND PRINTING V

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id.75-4550

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PRACTICAL ASPECTS OF DYEING AND PRINTING.

How do we make the best use of the present state of knowledge and technology? There are so many factors which can have an influence technically and/or commercially that each dyestuff class must be considered separately and the various features emphasised. Dyeing and printing may have different requirements and therefore are considered in turn.

I. DYEING.

Vat.

These are still essential for the fastest results, such as demanded by workwear. The standard technique of pigment pad - dry - pad in alkali and reducing agent - steam and oxidise - gives good results and is eminently suitable for continuous processing, particularly in large "runs". For small quantities, the reduction stage may be carried out on the jigs, but good control of temperature, liquor volume, salt additions etc., are necessary to obtain shade consistency. In mixtures, dyestuff selection must consider individual dyeing properties so that they are approximately similar in behaviour. The preparation of the pigment pad liquor requires care and all the leading dyestuff manufacturers produce suitable good quality vat dyestuff pastes which are relatively non-settling and well dispersed. As some vat dye stuffs are chemically complex and therefore relatively expensive, it may be advisable to store the unused pigment impregnation liquor. This is quite usual and covers are desirable for the containers.

Obviously the dried pigment padded fabric gives little indication of the final shade and this may be a slight disadvantage compared with the other dyestuff classes. Nevertheless for tertiary shades, vats offer a better choice of dyestuff.

[redacted].

These are increasing in usefulness as the ranges extend. Brightness is their important property but beware of chlorine, light and perspiration

fastness of occasional members. In equitorial climates, perspiration problems occur on a scale not met with in northern Europe and practical tests are desirable before use rather than to accept published figures. The weakness is due to the extraction by perspiration of the metal from the dyestuff complex and occurs mostly in shirting.

Application techniques can be varied according to fabric construction, apparatus available and water supply, but the results are good and can be constant. The shade at the moment of application is usually very little different from the final result and this can simplify control. It is rarely useful to store unused solutions owing to their instability, unless dyestuff and alkali are mixed at the padding mangle itself; so check the cost for small fabric quantities in dark shades.

In the pad - dry - bake sequence, urea is employed and occasionally this will adversely affect chlorine resistance.

Direct.

These are the cheapest range but their solubility and ease of application mean that washing fastness is not good unless after-treated. Many members possess good fastness to light and this can offer useful outlets. If the market justifies the necessary bulk quantities, continuous processing is possible.

Sulphur.

This represents an intermediate dyestuff class particularly since the introduction of sodium hydrogen sulphide as solubilising agent. On the whole, their cost is not high and some shades of workwear could be economically produced, provided the diminished chlorine resistance is not a disadvantage. Continuous processing is possible but the range of available shades is limited.

Naphthol A S series.

This range is essential for some members of the spectrum. Wash fastness is usually very good, but light fastness is variable. Hot

ironing can occasionally produce irreversible colour changes. Fastness to rubbing is their main problem and a good padding mangle is a pre-requisite. Even then, the passive component (naphthol) requires careful selection. Exposure to light before "coupling" must be avoided, and if this second stage cannot be undertaken immediately, the naphtholated goods must be well covered or preferably batched. For small quantities, jig "coupling" is satisfactory. A few members of the active component (base or diazo salt) are expensive, so check the price of the selected combination.

Other Possibilities.

Aniline Black is cheap and almost foolproof if the appropriate application range is available (such as often exists in a printworks). Beware the problems of storing sodium chlorate - many fires have been caused.

The shade of Phthalocyan Blue renders its use indispensible, but the other members of this series have not found extended use. Fastness is superb. The green is a beautiful shade but costly.

Solubilised vats (Indigosols, Soledons) are very expensive, but their ease of application renders them useful for many pale shades.

Pigments might be justified occasionally, particularly for pale shades to be resin finished.

Machinery.

Most of the above dyestuffs require application by padding and careful planning of this can bring its rewards. Fabric widths vary and cause gradual wear of the nauls, even although a traverse motion of the material is introduced. This problem can be eased in a works endeavouring to dye both wide and narrow fabrics. One solution has been the construction of a padding mangle in which two alternative padding troughs may be quickly interchanged into the framework. A further important feature is hot air drying in the earlier stages to reduce migration. Cylinder drying will then have no adverse effect when the moisture content is below 40%.

Vacuum impregnation is new and may have advantages in certain cases, e.g. impregnation of grey fabrics; padding of circular knitwear.

A few jigs will always be useful but ensure they have a constant circumferential speed and are fully enclosed. Strive for continuous processing but wenders will arise and their correction will probably be on the jigs.

II PRINTING.

Vat.

Regretfully this class should no longer be considered. Although well established methods of fixation are available, they are not as simple and foolproof in application as other classes we shall consider. For example, pale shades in large areas need careful mixing if "specks" are to be avoided. Preparation of the darkest shades known as "standards" require the supervision of a responsible person but the method of final colour mixing from the "standards" can be mechanised. In general, the print pastes are expensive and storage of unused paste is necessary. The true shade is not to be seen until after the final oxidation. Frankly, only furnishings can justify their use and even then, tendering of the cellulose by certain dyestuffs on exposure to light can give rise to complaints.

Reactive.

These ranges have simplified techniques enormously. Due to their solubility, it is almost impossible to produce a "specky" print and colour mixing is easy to standardise. Owing to the high temperature prevailing in many climates, individual dyestuff selection is important and if wastage of excess colour is to be avoided, special refrigerated colour storage conditions are helpful, if the final print paste contains the alkali necessary for the dyestuff - cellulose linkage. The number of fast-to-light members is steadily increasing and nowadays will satisfy all but the most stringent requirements. Disadvantages are that an alkali pretreatment of the cloth is essential and some members are adversely affected by chlorine. Whilst efforts are being made to avoid the necessity of washing-off, at this moment

it is still necessary. Despite the increasing chemical complexity of these ranges, they are intermediate in cost between vat and pigment, and hence the wastage of dark print colours must be avoided. A useful advantage is their ability to print alongside other classes of dyestuffs, such as diazo compounds on naphthol prepared goods, phthalogen blue, pigments etc.. The appearance at the moment of printing gives a good indication of the final effect and the brightness of some members cannot be equalled in other classes.

Pigment.

This class is perhaps the simplest of all and the final colour is immediately apparent. There is also the advantage of not requiring washing-off and therefore effluent problems are reduced. Brightness in parts of the spectrum is not as good as with reactive dyestuffs, although fluorescent members are available, useful for specialist effects, but unfortunately of negligible light fastness. The dyestuff manufacturers are constantly striving for a softer handle and on many types of fabrics, there is no objection. It is only on the lightest fabrics that this problem becomes acute and one has to equate "handle" with ease of application and "rubbing" fastness. Despite claims to the contrary, "wet rubbing" is far from ideal, but how often is this a serious problem? It is not out of place to mention that, at this moment, 40-50% of all textile printing is with pigments. They have occasional speciality uses, e.g. the low pH necessary for their fixation can be used to produce resist effects under some reactives. They can be useful for the colour effects in the "devoré" style of printing.

Application of the Dyestuff.

1. Screen roller printing. After almost 200 years, one must admit that this method of printing can hardly be recommended for a new mill today. It is without an equal for the reproduction of fine lines, contacts and "loose" designs, known in the trade as "all engraved", as well as stipple or gradation effects, but the present day fashion demands bright, heavily covered designs, for which the "rubbing" and colour

contamination by successive rollers present limitations. It is also difficult to gauge the exact colour consumption and wastage of excess print colour is unavoidable. This necessitates a system of colour storage and re-usage, particularly with the more expensive dyestuffs.

Capital outlay for rollers and their engraving is heavy, although a start can be made by purchasing the "negatives" and acquiring only the means of exposure and etching.

2. Flat screen printing. This method is relatively foolproof. Engraving is easy and suitable for variable repeats and small quantities. If a constant design repeat can be maintained however and the base fabric standardised, output can be good, since an alternative design can be printed whilst the other screens are being washed, the two designs being intermingled in output. This principle can also apply to rotary screen printing.

Screens are not re-useable, although the frames last indefinitely. Any unused screen paste is easily recovered. This method of printing is labour intensive, equally suitable for males and females.

3. Rotary screen printing requires good screen-making and intelligent labour; it eliminates all forms of "crushing", thus giving good colour yield. Design fitting is excellent. 50% of screens can be re-used once and approximately 30% used a third time. Unused print paste is not too conveniently recovered. Screen engraving techniques have improved enormously, narrowing the gap between screen and roller printing. Precautions against colour contamination must be taken in heavily coloured designs, but the problem is not as serious as with roller gravure printing.

4. Transfer printing has come to stay and its impact will increase. Mention must be made of this method, although it is expensive and less likely to appeal in unsophisticated markets. In the U.K. in 1973, 19% of all textile printing was by the transfer method. Recent emphasis has been with sublimable dyestuffs on synthetic fibres, so that the process is dry throughout, but a recent development, necessitating after-washing, is

applicable to natural and synthetic fibres with a much better dyestuff selection. It must not be forgotten that transfer printing by pressure in a heated calender using vat and reactive dyestuffs on to cotton, acid dyestuffs on to wool etc., followed by conventional fixation processes, is not recent and yields excellent results. An Italian firm has been foremost in this field.

The technical problems are transferred to the paper printer - and most is being printed on gravure machines, although flexograph, lithograph and rotary screen are also being used - and for this reason, costs are higher than direct printing.

Designs may be confined or bought from stock, thus reducing dyestuff stocks and cash fluidity problems. Effluent problems are eliminated in the dry process and eased in the other variations. Colour transfer is not 100% and some concerns have been sufficiently astute to re-use the paper, usually on a dyed background to give subtle effects.

One of its merits is to print the final garment.

In any method of printing, dyestuff cost is the largest single item of controllable expenditure and it is strongly advised to measure colour paste consumption and to "cost" each individual colouring, which may vary to a surprising extent.

BLENDS III.

The previous remarks have concerned mostly 100% cotton fabrics.

Polyester-Cotton mixtures. No one dyeing method or machine will accommodate all types of fabric in as shades. In pale shades, solubilised vats are simple to apply, always bearing in mind their cost. A considerable increase in depth occurs if the final dyeing is heat treated; it is even more pronounced if the heat treatment is after impregnation and before hydrolysis.

Generally the thermosol process will be used. For workwear, a mixture of disperse and vat dyestuffs may be considered essential. A few vat dyestuffs will fix on both fibres, but the range is small and requires accurate temperature control at the higher end of the scale during the thermosol treatment. The bulk will be dyed with mixtures of disperse and reactive dyestuffs and this raises the problems of whether to buy premixed dyestuffs or to choose the individual dyestuffs one's self, particularly

if the fibre percentage will vary or cross-dyes are included.

Very wide fabrics are often beam dyed.

Polyester-Viscose presents problems of a different kind. Continuous thermosol methods may give rise to "frosting" on the surface of the viscose. Jet dyeing is good but cannot be used for smooth faced materials such as satins. Carrier dyeing may introduce different problems caused by emulsion breakdown and the production of carrier spots. Light fastness is sometimes reduced.

Fabric qualities, their widths and range of required shades will determine the dyeing apparatus and a most careful survey must be made beforehand of the differing possibilities and their characteristics.

Fibre contamination.

When processing mixed fibres, a new problem will arise and it is unknown to meet a firm which has not suffered from fibre contamination at some stage. It can occur at almost any stage during spinning, winding, warping etc., The original fibres can be spray tinted in the hopper but the problem becomes really acute as the yarn gets on to bobbins, creels, cones, beams etc., and a "colour" code throughout is necessary, supported by examination under fluorescent lighting. Even so, wrong warp ends will still occur and it is advised that the initial end from the loom be checked by a simple dyeing technique. Faulty pieces can then be allocated appropriately, e.g. to plain white or pale tints, or to be printed. Countless so-called dyed cotton pieces have contained odd undyed white polyester warp ends and it is then usually too late to correct at reasonable cost.

IV. BASE FABRIC.

As most continuous dyeing operations involve a padding operation, the quality of raw cotton and its nep content may be important. It is a pity that some good growths are spoiled during gathering or in ginning, but the I.I.C. is gradually effecting an improvement. Worse still, many bulk deliveries of cotton do not correspond with that bought from sample - just sheer carelessness.

Despite all precautions and the latest techniques in spinning and weaving, gray inspection and classification will always be necessary, so

that fabric can be allocated to its optimum advantage. Grey storage and inspection requires a surprising amount of space. Good cropping and shearing must be included.

Dare one mention the importance of good sewing. The mere provision of a good butt-end machine does not automatically solve this item - possibly the largest single cause of faulty work. Rigorous standards must be imposed throughout the factory to prevent amazing quantities of faulty cloth, which could have been avoided, mainly due to pieces not being aligned exactly edge to edge. Pieces of the same quality may vary in width from different looms, but since, in any particular quality, they contain an identical number of warp ends, there is no excuse for width variation or creases across a seam. Simple teaching in correct sewing technique is all that is required.

In the interests of cleanliness and wastage, large batches will be employed. These can give difficulty in correct alignment with machinery, but a simple device exists to eliminate this. It was seen in Brazil and consisted of two ideas. The first was a simple clamp joining the batch-stand with the machine, - and the second was a screw principle of moving the batch transversely or backwards and forwards relative to the machine. Simple but extremely effective.

Another cause of faulty work in dyed fabrics such as poplins is due to creases in chainless mercerising, particularly when two widths are processed side-by-side, perhaps of different qualities. This cannot be avoided even in the best machine of this type.

V. GENERAL RECOMMENDATIONS.

What are the trends? Weaving is remaining constant and the increase in textile output is coming from knitting. The percentage of printed goods has increased. 100% cotton fabrics are decreasing and being replaced by blends - this is hardly the time and place to discuss the ecological reasons governing land available for fibre and food growth. At a U.S.A. conference in January 1975, it was forecast that by 1980, all cotton there would only have 10% of the market; roller printing was used for 87% of all printed cotton goods in 1965, but

that by 1978 it will drop to 20% and by 1980 to 10%. Knitted goods are rapidly approaching 50% of wovens, and of this, 40% is polyester, of which 25% is printed. The European position is expected to follow these trends. In 1973, 42% of the print production was composed of synthetic fibres and blends.

It is surprising how different countries can vary with a particular article. At a seminar on Household Textiles earlier this year, the following figures were quoted for the European Sheeting Market for 1973/1974.

	100% Cotton.	Polyester/Cotton.	Others.
Germany	80 - 85%	4%	10 - 15%
France	74%	14%	12%
Italy	75 - 80%	4%	15 - 20%
Holland	99%	Negligible	Negligible
U.K.	45%	20%	35%

The figure of 35% for other fibres in the U.K. consists almost entirely of knitted nylon sheets. Nowhere else in Europe has nylon attained such a high share of the market.

Traditionally, sheeting fabrics have been all white or in pastel shades, but in recent years fashion has entered into the domestic sheet market. We are now seeing strong, bright, attractive colours, both in plain dyes and in striking prints, the latter sometimes matching the bedroom furnishings.

Where do we go from here? Which dyestuffs and printing methods suit your particular needs best? Experiences have demonstrated clearly that, prior to the installation of a textile finishing factory, market research has been inadequate and too narrow in outlook. It seems to be the custom, to examine the figures of imported fabrics (often inaccurate), to look at the fabrics currently being produced locally, and then, to engage a firm of consultants or to come to an arrangement with a comprehensive machine manufacturer. The results rarely are to the

satisfaction of both parties.

Let me give you some examples of what has been seen during the past decade.

1. A factory designed for 80% white goods, basically of the poplin type, with continuous rope bleaching. Events soon demonstrated that the planning could not have been more wrong. The dyed proportion increased many fold, and an open width bleaching system had to be devised. Both aspects should have been foreseen.

2. A new mercerising machine of the chain variety <u>without</u> washing-out some alkali whilst under tension on the frame. Regretfully the principles of good mercerising seem to have been forgotten generally and the work of the I.T.C. in this field is a timely reminder.

3. A beautiful new Schreiner calender which had not processed a single metre due to fashion changes.

4. A new singeing machine installed during 1974, in which there was no feed tank for the after-quenching (usually enzyme).

5. Ill advised stocks of dyestuffs and chemicals. One firm had a large stock of sodium chlorite - for bleaching - which can be excellent, but had not been used because the ventilation problems involved had been overlooked. Dyestuffs had been purchased before production details were known. This opportunity is taken to mention that there must be frequent examination of dyestuff stock records and determined efforts made to use up discarded products. Styles change, new products introduced etc., and it is so easy (but not negligent) to overlook the consequential inactive capital.

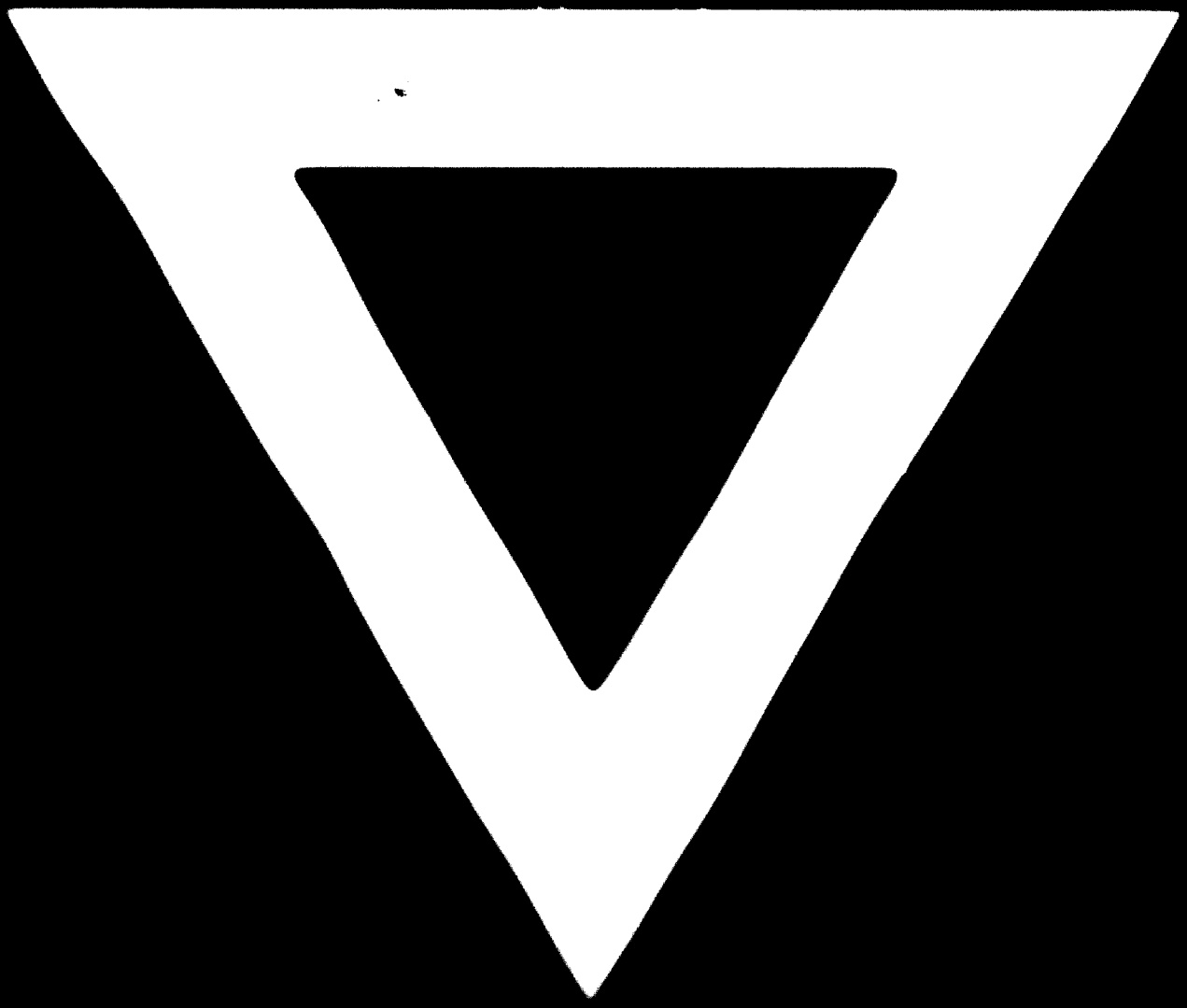
6. Narrow finishing machinery, completely ignoring manufacturing trends, and thereby limiting their competitiveness and manufacturing expansion. Occasionally finishing machinery can serve the dual purpose of being able to process knitted and woven fabrics.

7. New star steamers - good, but nevertheless, a poor choice in a "bulk" works, when continuous high temperature steamers are available and also suitable for other purposes than fixation of disperse dyestuffs.

8. An agar in Tehran was alleged to be giving poor results in the discharge printing of vat dyestuffs on dischargeable grounds. The ventilators at the rear of the machine were fully open, thus allowing accumulation of air, and after closing the ventilators, no further problems were experienced. This was a pitiable case, because the Iranians were being "trained" but the teachers had only experience of pigment printing.

9. POOR and INADEQUATE colour mixing and storage conditions - this is fairly common and yet the department is so important. Colour mixing may be "dirty", but it is most interesting and can be made less unpleasant and even partly mechanised. A new machine has just been manufactured which can sprinkle measured quantities of a dry powdered thickening agent into water and thus yield thickenings, such as guaranates, alginates, locust bean etc., continuously.

Where do you go for advice? Apart from the essential research into market needs and future trends, what are the needs in respect of labour; what is the energy position; are there water supply and effluent problems (process water is sometimes re-usable)? The I.I.C. has world wide contacts and know the best people for any particular needs. They have no bias or outside pressures. The large dyestuff manufacturers "know" the world and its trends and can be extremely helpful - long before dyestuff purchases are involved. Does your country want or need the best commercial practice? This may not be necessary or advisable; it is so easy to answer "Yes", but in a textile factory sited amongst what was previously considered an agricultural community, labour may not appreciate the true meaning of the word "efficiency". A country's immediate needs may be labour intensive with a desire only to change gradually to becoming capital intensive or efficient technically.



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