

Mutagenic dyes in textile finishing

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The European Project "Identification and Substitution of Mutagenic Dyes in Textile Finishing (QLK4-CT-2000-70158)" was funded under the 5th Framework Program of the European Commission. The project was carried out to support textile companies (TCs) to make their production safer for consumers, workers and the environment. Here the results of the project are presented and the process of identification and substitution of mutagenic dyes in the textile industry is described in detail.

It is generally assumed that substances which are used to produce textiles are thoroughly tested regarding their health consequences. However in recent years various researchers have identified mutagenic effects of textile samples and waste water of the textile industry [1,2,3,6]. Further investigations showed that the dyes used for textile finishing are mainly responsible for the mutagenic effects observed [7] and that these effects can also be measured in samples from European TCs independent of the care and quality standards applied by the textile companies during production.

Most textile dyes in use are so called "existing substances", which were placed on the market before 1983. Only since 1983 have new chemicals had to be examined for mutagenic effects for notification [4,5]. It has already been known for some time that the breakdown products of certain azo dyes have carcinogenic effects and these are now regulated by law. However, because of this legal situation in regard to the investigation of old substances a mutagenic potential for many other dyes cannot be ruled out. Mutagenic dyes are a risk for the health of workers and consumers and for the environment. Especially workers can be exposed to high concentrations when preparing the recipes for the dyeing process. Mutagenicity of chemicals present on textiles can be seen as a major clue towards carcinogenic activities of these chemicals.

Project partners

Nine textile companies from 8 European countries and 4 research institutes participated in the project "Identification and Substitution of Mutagenic Dyes in Textile Finishing (QLK4-CT-2000-70158)" (Table). The objective of the participating companies was to identify mutagenic products, replace them, and develop a generally valid strategy to avoid the use of these products in their operations in future. Beyond this, the results should be suitably presented so that other textile finishers will be enabled to adopt the strategy to identify and substitute mutagenic textile dyes.

Results

- Existing data

The TC partners provided Safety Data Sheets (SDS) on 281 textile dye products. These products are from 11 different dye producing companies and providers from countries all over the world.

The first step to identifying mutagenic textile dyes was a detailed literature survey. In addition, textile dye producers were asked for their cooperation. Mutagenicity data in published literature

or other publicly available sources (e.g. databases, authority reports) and in the safety data sheets were scarce, while data for 174 products could be provided by the dye producers. For a total of 98 products (35%) no mutagenicity data were available [9].

- Test results

Missing results were completed by examinations of dyes, dyed textiles, and waste water from dyeing processes with internationally standardized test systems.

About 100 textile samples, 15 waste water samples and 53 dye samples were examined in the Ames test, a standard test for gene mutation in bacteria as recommended by the EU. The Ames test was performed with strains TA98 and TA100, in all other criteria according to

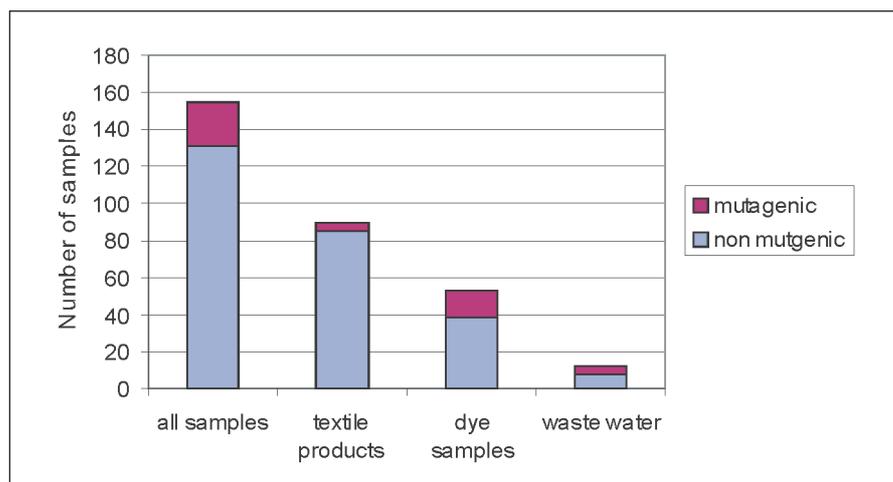


Fig.1 Ames test summarized results

Consortium of the project		
Organization	Country	Business activity
Simmendinger Textilausrüstung GmbH	D	Textile finishing company; dyeing of cellulose based and micro fibers
Novotex A/S	DK	Trading company and Manufacturer of ready-to-wear-clothes
Farbetex	EL	textile finishing company; dyeing of wool, polyamide and acrylic
Ovelacq BVBA	B	Textile finishing company; dyeing of polyester
Baumann Textildruckerei	A	Textile finishing company; printing curtains and furniture fabrics
Société d'Impression de Vieux-Thann, SA	F	Textile finishing company; printing of different fabrics
Alkena GmbH	CH	Textile finishing company; dyeing of silk
TZP a.s., Hlinsko	CZ	Textile finishing company; dyeing of yarn
Gössl	A	Manufacturer of garment collections
Hydrotex GmbH	D	GLP-Research Institute
FoBIG GmbH	D	Toxicological Research Institute
Inotex Ltd	CZ	Textile Technology Research
Institut Francais Textile-Habillement	F	Textile Technology Research

the international test guideline OECD 471. Overall 18% of the samples were mutagenic in this test including 6% of the textiles, 28% of the dyes and 30% of the waste water samples (Fig. 1).

Additionally, Mouse Lymphoma Assays, an in vitro mammalian cell test according to EU legislation, were performed with nine Ames positive dye products. Six (70%) were also mutagenic in this test [8].

- Evaluation of Data

Aggregation of Mutagenicity data of all 281 used dye products in the Access database MUTATEX allowed an in-depth evaluation of these products. Using test strategy criteria in analogy to the EU chemical legislation process, all products were assigned to categories. Depending on the data, 7 categories were made (Fig. 2). To make understanding and communication easier, these were then grouped into three main categories for the substitution process.

- non-mutagenic (green)
- unclear or missing test results (yellow)
- mutagenic (red)

106 of the evaluated products are non-mutagenic ("green"), 159 have unclear or missing results ("yellow"), and 14 are mutagenic ("red") (Fig. 2). The evaluation of the dyes is described in detail in Schneider et al. (2003) [9].

Substitution process

There are several necessary steps to successfully introduce a mutagen free production to a textile finishing company (TFC). When manufacturers can participate in this process they can turn, as appropriate, to the TFCs that deliver to them.

Before the general substitution strategy is presented, the findings during the project will be described.

- Properties of substitution products

Dye products which are suitable for substituting mutagenic dyes are called substitution products. These dyes must have similar technical properties, e.g. color, fastness and possible use with the same dyeing process. In addition they must be non-mutagenic ("green"). Last but not least, the price is also an important criterion.

- Communication

In a first step, dye producers were contacted and asked for suitable substitution products. This first step is especially critical. It seems to be trivial but the process can only be successfully accomplished when the right questions are asked to the right people. It is very important who is contacted, as not every person in a dye producing company has sufficient knowledge to be able to respond factually to the questions asked. It can also be difficult at the beginning to interpret the answers given by a manufacturer and then to actually select a better product. Here it may be advisable for a textile finisher to seek external advice at least for a transitional phase. To be sure that all necessary information for the evaluation is provided, a special form sheet was developed which should be filled in by the dye producer.

Within a textile finishing house the process can be made easier and faster by a fundamental decision regarding their dealings with the dye manufacturers who are not willing to provide the necessary information.

- Testing the technical dyeing characteristics

After a suitable product has been named, the TCs are able to first test the dyes in the laboratory in order to adapt

the recipes. After these investigations have been successfully completed, dyeing can be carried out on a larger technical scale.

- Price

New and well investigated products can be expensive. The calculated price increases for substitution products were between 20 and 80%. 20% was regarded as practicable, while at 80% the possibility was discussed by the concerned company to temporarily continue to dye with the available dyes of the "yellow" category or to eliminate the dyes involved completely. At a partner company all the recipes with substitution products were even cheaper than before.

- Substitution

During the project, 14 mutagenic dyes were identified. Five of these dyes could already be substituted successfully. Additionally, production was stopped by the dye producer for one dye product. Four were eliminated, two because no suitable substitution products could be found, two others because of low volume. Four others are still in the test for substitution. Recipes for substitution are expected to be found soon.

- Complexity in the textile chain

The complexity of this process is increased when a confectioner decides to sell only "mutagen free" textiles in future. The confectioner cannot directly inquire with the dye-manufacturer, because the latter is only willing in individual cases, if at all, to provide such information about the dyes used directly. Consequently, the confectioner must make contact with the finishers and inform them of the decision. When a confectioner works with many finishers or when the contact even proceeds via intermediary distributors, as is often the case, then this process becomes very complicated and time consuming. Here it is especially important to formulate clear specifications and to inform the companies involved in personal discussions. For this purpose, in the project a pilot workshop was successfully run with the parties involved from all parts of the textile chain.

Substitution strategy

The experience of the project led to a general substitution strategy which is shown and described in the following (Fig. 3).

- 1) Companies should prepare a complete list with the names of currently used dyes.
- 2) All safety data sheets for these dyes must be analyzed.
- 3) A literature survey to find all scientific data available can be performed.

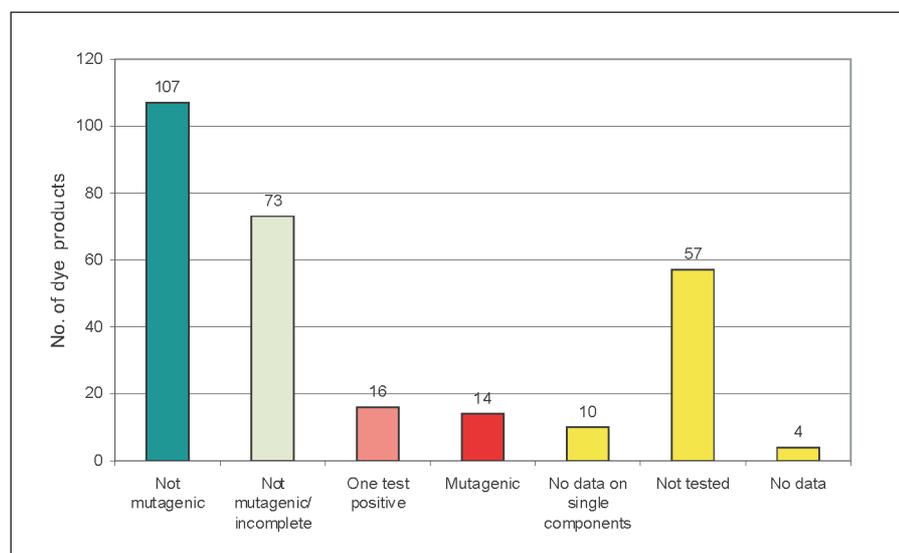


Fig. 2 Summarized results of the evaluation of 281 dye

- 4) A questionnaire must be sent to the corresponding dye producers for additional data.
 - 5) Dyes must be classified into categories as "red", "yellow" or "green".
 - 6) "Red" category products must be substituted or eliminated.
 - 7) Dye producers will be asked for technically suitable products which are not mutagenic.
 - 8) These alternatives must be tested in the TCs on a laboratory scale and subsequently on a technical scale in the dye house.
 - 9) Producers can be asked for additional tests to evaluate dye products in the "yellow" category.
 - 10) "Yellow" products must be re-evaluated (e.g. with additional tests) as "green" or also be substituted.
- To complete the process it seemed promising to inform workers, customers and consumers about the efforts towards a safer production. Currently the project partners are discussing suitable ways to communicate the success of their efforts to customers and consumers via product labels and/or certification of their production processes which comply with these high health standards.

Summary

In this project it could be shown that in

the textile industry mutagenic dyes are still being used and that efforts are still necessary in future to solve this problem.

All participating TCs were able to substitute or eliminate dyes which were identified to be mutagenic and to implement the general substitution strategy. Experience has shown that depending on the placement of the dye in the production process the amount of effort can be quite variable, but that substitution is in principle possible. Thus the participating companies have a great advantage over other European textile finishers. They already know how their dyes are to be rated and that in their operations dyes in the mutagenic "red" category will no longer be used. It is desirable that other textile companies also adopt the developed substitution strategy. The result would be a significant improvement of the safety of the workers and consumers, the whole European market would be strengthened, and protection against imported textiles would be facilitated.

The results are transferable to the European leather industry and to the manufacture of stuffed toys and other textile products and will also help the companies to meet the criteria in REACH.

Access = registered trademark

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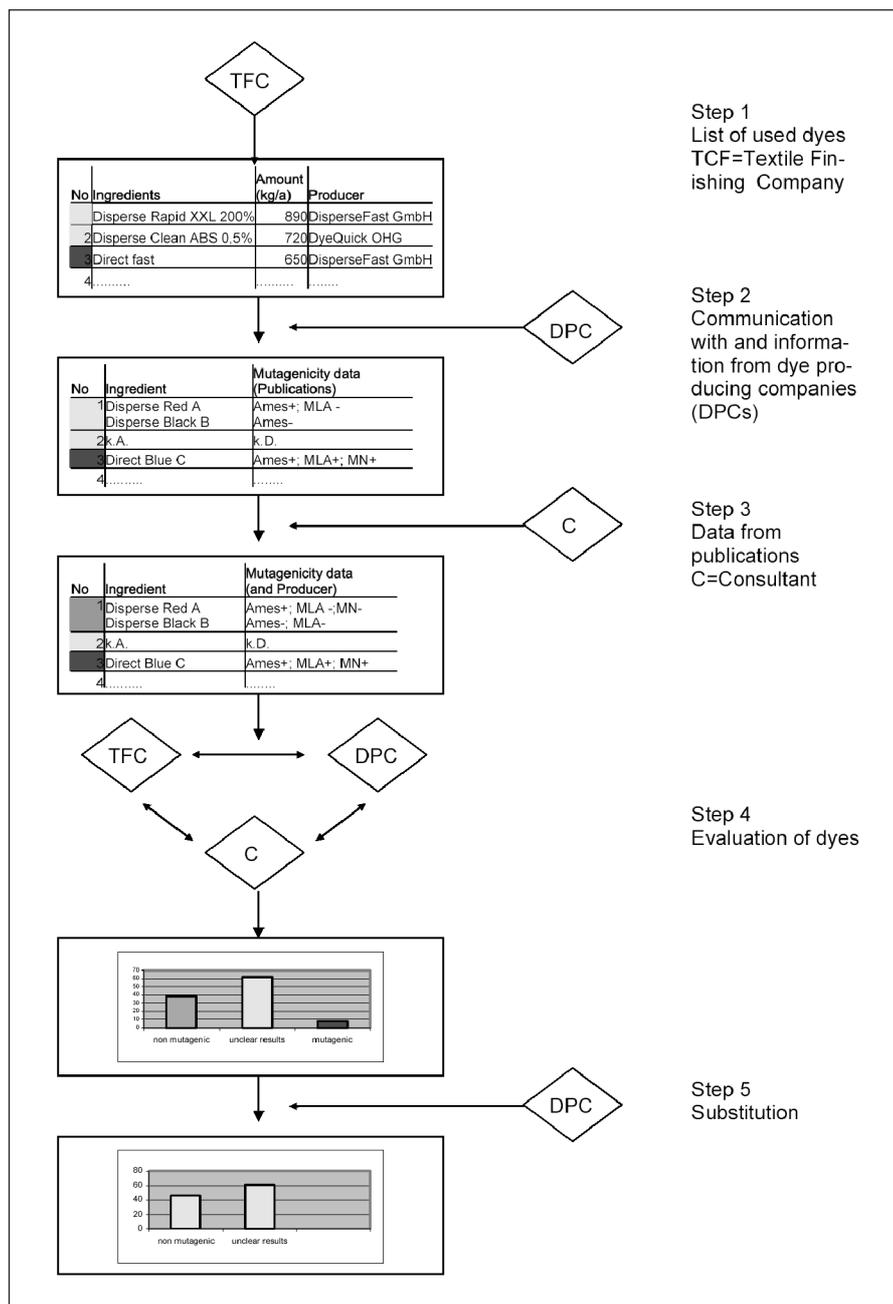


Fig. 3 Substitution process