

Ciba Specialty Chemicals



# Ciba® PYROVATEX®

Flame Retardant Finish

Ecologically Safe

Textile Finishing

Value beyond chemistry

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## Ciba Specialty Chemicals Inc.- Value Beyond Chemistry

Ciba Specialty Chemicals Inc. is one of the world's leading organizations dedicated to producing high value effects for its customers' products.

Active in a variety of industries including the textile market, Ciba develops, manufactures and markets a complete line of leading textile chemicals in more than 117 countries - adding value to virtually every step of the textile manufacturing process. Our innovative products enhance the performance, look and feel of fabrics; create comfort; promote care and provide protection.

Ciba Specialty Chemicals Inc. has also been evaluating the ecological value of its products for quite some time. This brochure highlights our ecological commitment.

### **PYROVATEX® - Maximum Protection combined with Superior Comfort**

PYROVATEX® was introduced in 1960 as a durable flame retardant product for cellulose fibers. Continuous improvements have reflected changes in market requirements and environmental awareness, yet one thing has remained constant since its introduction:

PYROVATEX® offers the maximum combination of overall flame and heat protection and unsurpassed comfort available in treated garments.

PYROVATEX® has been used to treat more than 100 million linear yards of fabrics. Garments produced from these fabrics provide life-saving protection to people around the world.

### **Excellence in use**

New product properties are mainly checked by laboratory studies prior to introduction. In addition to lab test results, however, 40 years of experience have provided us with considerable end use knowledge of PYROVATEX® treated fabrics.

PYROVATEX® has been successfully applied to a variety of textiles. In each of these segments we have dealt with different conditions of use.

From use in flame retardant (FR) work wear, we have learned how to achieve maximum durability under the conditions of industrial laundering. We have also acquired insight as to how the garment affects the wearer during use. For example, firefighters or welders who must work very hard, perspire. Their underwear or clothes made of PYROVATEX® treated cotton are in direct contact with their skin. If there were a negative effect on either the skin or body, it would quickly become obvious.

Cotton treated with PYROVATEX® is also frequently used in home furnishings. The extensive use in this area without any observed eco-toxicologically related problems also confirms that PYROVATEX® is a safe product if applied according to our experience and recommendations.



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## General remarks

The eco-toxicological behavior of cotton fabrics treated with PYROVATEX<sup>®</sup> has been studied since PYROVATEX<sup>®</sup> was first introduced into the market 40 years ago. The test results gained during this period have been published on the following pages of this brochure.

As mentioned above, millions of meters have been treated and used in different textile outlets over the last 40 years. It is well known, of course, that real life conditions are often much more complex than those of standardized tests.

Scientific test results, combined with our extensive practical experience, allow us to make the following statements:

- The PYROVATEX<sup>®</sup> molecule is bonded to the cotton fiber by a chemical link so that it becomes a part of the fabric matrix. The bond is stable against usual wear and care conditions. Recommendations for care conditions have been developed and should be respected. There is almost no difference between cotton treated with PYROVATEX<sup>®</sup> and untreated cotton with regard to contact with the human body.
- Extensive studies and experience show that cotton treated with PYROVATEX<sup>®</sup> is not harmful to human beings and does not cause any skin irritation.
- The PYROVATEX<sup>®</sup> formulation does not contain any halogens or heavy metals. This is important for its burning behavior. The burning gases differ only slightly from the gases formed by untreated cotton. For the same reason, the biological degradation of treated and untreated cotton after the use of the fabric is very similar.
- Textiles finished with PYROVATEX<sup>®</sup> CP can be certified according to the Eco-Tex Standard 100 (product class IV, decoration material)
- The PYROVATEX<sup>®</sup> molecule contains formaldehyde. Intensive research work has shown that the formaldehyde content of cotton which is treated with PYROVATEX<sup>®</sup> stays below 75 ppm. This level of 75 ppm formaldehyde is relatively low and is accepted by the Eco-Tex Standard 100 for clothes with direct skin contact.

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## Dermatological Laboratory Studies

### Direct contact with dry skin (Epicutaneous Tests)

Clothing textiles are sometimes worn directly on the skin, or as in the case of outer garments, in close proximity of the skin. It is therefore essential to test the textile's compatibility to the skin.

Tests are carried out under the supervision of renowned dermatologists. Test persons with particularly high skin sensitivity are chosen for these examinations. The method to determine if a textile material causes skin irritation is as follows:

The textile sample to be examined is brought into direct contact with the subject's skin for an extended period of time. The dermatologists then decide whether a skin irritation has resulted from the textile sample.

Test Institute	Number of Test Persons	Contact Time	Special Conditions	Results
Food and Drug Research Lab. Inc. Conshocken, Pa, USA	50 persons	24 hours after one application, in total 15 applications per person	Using textile material treated with PYROVATEX® as well as PYROVATEX® itself	None of the applications caused any reaction
Canton Hospital Zurich, Dermatology University Clinic, Dr. W. Gloor	30 persons, mostly eczema sufferers		Three different fabric patches	None of the 30 persons showed a positive reaction
San Francisco Medical Center, University of California, H.I. Maibach	103 persons	48 hours after one application, in total 10 applications and a 11th application after 2 weeks	testing irritation and sensitization	No change of the skin could be seen from the tested parts both during the induction period and after the challenge application
Director of the Dermatological Hospital of the City Hospitals Dortmund, Prof. med. H. Tronnier	50 persons	24-, 48- and 72-hour test-cycles		Test did not show any hint of primary irritation or release of an already existing allergy against the product

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## Indirect skin contact: Tests with saliva and sweat extracts

Besides being in direct contact with the skin, textile ingredients can affect the body in another way.

Secretions produced by the human body can leach or dissolve textile finishing ingredients when in contact with the skin and thus make these ingredients biologically available. Theoretically, the ingredients can now penetrate the skin and enter the body. The relevant secretions are sweat and saliva, with saliva being of special interest for babies' and children's articles.

With the corresponding extraction, synthetic solutions, so-called secretion simulators are used, imitating the properties of sweat and saliva. Samples of cotton finished with PYROVATEX® are treated with this solution and extracted under defined conditions. Then this extraction is examined by the medically accepted "in vitro" method (i.e. without animal experiments). The methods and results are summarized below. If you are interested in details of the results, please contact us.

Test	Target	Method	Result with Sweat Extract	Result with Saliva Extract
Cytotoxicity Test	Assessment of the acute cytotoxicity potential of leachable components in the textile material	ISO/TR 7405-1984 and DIN V 13930	No Cytotoxicity neither tel quel nor in the simulance extraction	No Cytotoxicity neither tel quel nor in the simulance extraction
BECAM Test	Determination of the eye irritation potential	Using the combined bovine eye/hens egg-chorioid-allantoic membrane test (BECAM)	No eye irritation	No eye irritation
Skin Permeability Tests	Assessment of chemical penetration through human skin	As a substitute for the penetration test, the skin of a pigs outer ear is used.	No Penetration through the skin	test was not performed
AMES Test	Assessment of the mutagenic potential (likelihood of causing genetic change)	Back mutation test with Salmonella Typhimurium strains (TA 98 und TA 100)	No Mutagenic behaviour under experimental conditions	No Mutagenic Behaviour under experimental conditions
Lymphocyte Blastogenesis Assay	Test was performed to investigate the immunotoxic potential	Assessment by using spleenocytes of mice	No immunotoxicity under experimental conditions	No Immunotoxicity experimental conditions

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## Examination of gases released on combustion

A further safety aspect of cotton treated with PYROVATEX® is its burning behavior.

If an organic material burns, the mixture of the material and oxygen supply to the source of the fire determines the quantity and kind of the released fire gases.

PYROVATEX® only changes the structure of the material by incorporating phosphorus and nitrogen atoms. This change causes the carbonization of a large part of the fiber matrix, thereby reducing the quantity of flammable pyrolysis gases, which leads to the flame retardant properties of PYROVATEX® treated cotton.

In connection with the formation of combustion-released gases, we have directed EMPA in St. Gallen (Switzerland) to examine the behavior of cotton treated with PYROVATEX® using a test developed in the aeronautics industry. The test is called Airbus Industries Technical Specification Fire Smoke Toxicity (FST) Specification No. ATS - 1000.002. We have obtained results from a number of different test methods. For reasons of clarity, the following table simply shows the results of cotton treated with PYROVATEX®, with and without additional flaming at different times, and compares the results to the limits specified in the ATS regulations.

	<i>Material: PYROVATEX® treated Cotton</i>			<i>Limiting Value in ppm</i>
	without additional flame			
	1,5 min. value in ppm	4 min. value in ppm		
hydrogen cyanide HCN	2	5	150	
carbon monoxide CO	150	300	3500	
nitrogen oxides NO, NOx	1	1	100	
sulphur dioxide SO2	0	0	100	
hydrogen fluoride HF	1	1	50	
hydrogen chloride HCl	0	0	500	
ammonia NH3	0	0	1000	
hydrogen bromide HBr	0	0	50	

The results of this test show that the toxic gases formed in the case of fire are well below the limit value. Other tests also show that the combustion gases of cotton treated with PYROVATEX® are very similar to those of untreated cotton. Cotton finished with PYROVATEX® leads to a low density of smoke gases and a low concentration of combustion gases that irritate the respiratory tract.

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## Knowledge in the field of disposal

With regard to old textile material disposal, both waste incineration and disposal technologies are possible.

The same findings as for the behavior in the case of fire apply for incineration. We do not expect additional or special emissions other than those generated by general domestic waste. The forming of chlorinated or brominated dibenzodioxins or -furans for example is **not** even theoretically possible due to the absence of halogen atoms in PYROVATEX® CP. Concerning the disposal of waste, no changes in the decomposition behavior of flame-retardant cotton are to be expected. We do expect, however, an additional formation of phosphate either as ammonia or nitrate in the leachates of the dumpsite. This additional input can be disregarded as negligible, as the proportion of textiles in domestic waste is relatively small compared with the remaining N- and P-containing components of the waste.

## Summary

The combination of extensive eco-toxicological testing and practical experience confirms that PYROVATEX® is a safe product, when properly applied and cared for in accordance with instructions and technical literature, and offers the best overall flame protection available for cotton fabrics.

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