

# EIS-ChemRisks Report: rischi ed effetti sulla salute umana derivanti dall'esposizione alle sostanze chimiche contenute nei manufatti tessili

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- The main functions of clothes are protecting from environmental injuries and helping to regulate skin temperature and moisture.
- Natural and synthetic fabrics used in the manufacture of clothing cause almost no skin problems.
- Clothing dermatitis are generally attributed to chemicals and dyes added to these fibers during their manufacture and assembly into garments. In particular, responsible agents are represented by finishes, dyes, metals, rubber and glues. Also optical whitener, biocides, flame retardants and other agents are occasionally recognized as causative substance.

- Clinically, clothing dermatitis may vary for **aspect** and/or **distribution**. Any location where the clothing is held more tightly against the skin is a likely spot for textile dermatitis. Sometimes, other sites not directly exposed to sensitizing substances, as face and hands, can be involved as well.
- Variations in fashion, styling, new leisure activities and technological progress explain the changes of clinical patterns and allergens in clothing dermatitis.

# TEXTILE DERMATITIS

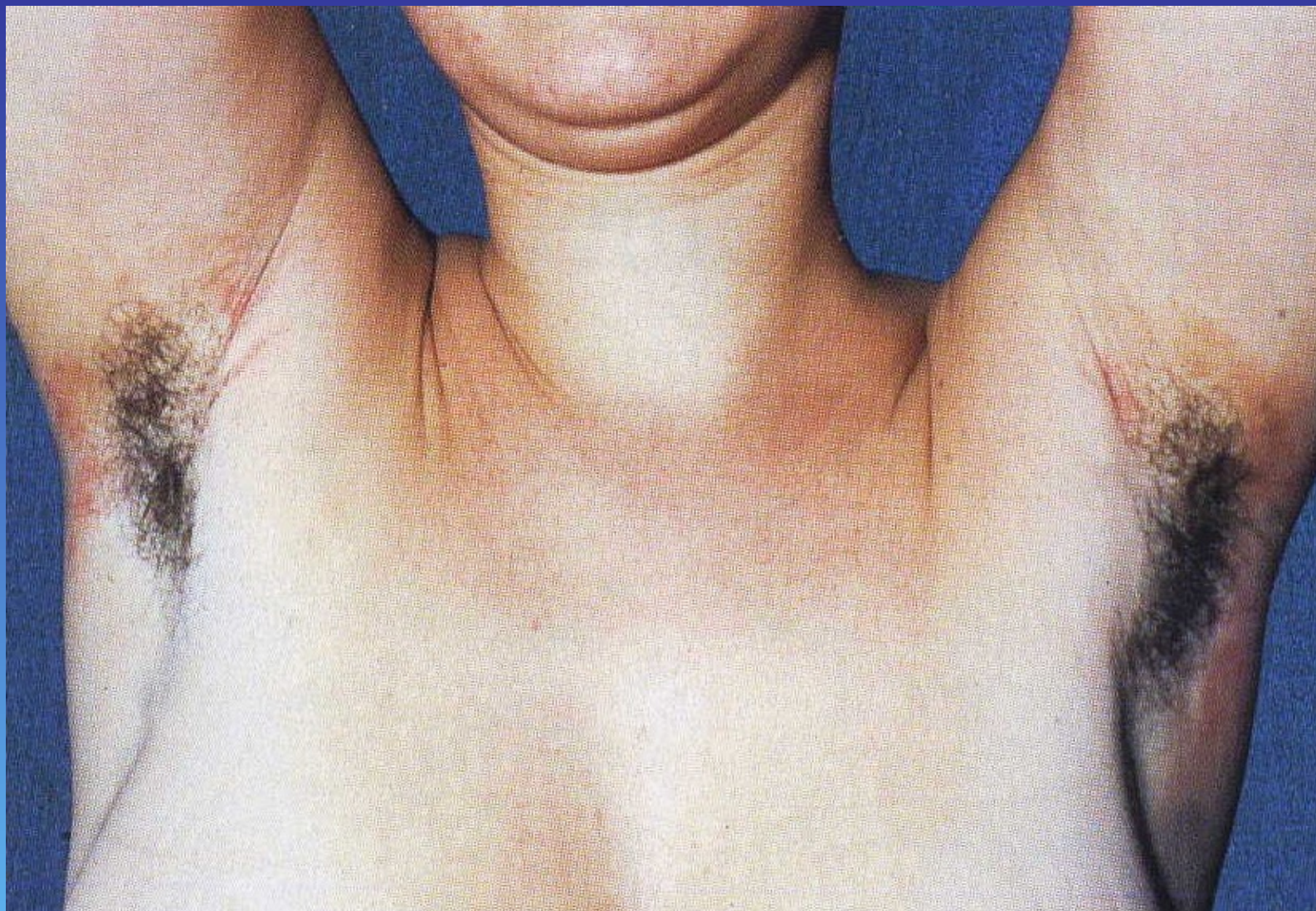
- ALLERGIC CONTACT DERMATITIS
- OCCUPATIONAL ALLERGIC CONTACT DERMATITIS
- CONTACT URTICARIA
- ERYTHEMA MULTIFORME-LIKE CONTACT DERMATITIS
- PURPURIC ALLERGIC CONTACT DERMATITIS
- PIGMENTED CONTACT DERMATITIS
- PUSTULAR ALLERGIC CONTACT DERMATITIS
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- CONTACT DERMATITIS PRESENTING AS LICHEN AMYLOIDOSUS
- PHOTOTOXIC TEXTILE DERMATITIS
- IRRITANT CONTACT DERMATITIS
- MILIARIA
- FOLLICULITIS
- PRESSURE URTICARIA
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# ALLERGIC CONTACT DERMATITIS

- **Textile ACD** generally presents with lesions characterized by erythema, oedema, vesicles and subsequent desquamation as other forms of allergic contact dermatitis; it interests sites where clothing is held more tightly such as neck, axillary folds, groin, popliteal fossae, buttocks, inner and anterior thighs. Friction, overweight and sweating are considered determining factors on the distribution of the dermatitis.

- Although sparing of parts of the skin protected by underclothing is a frequent distinctive feature, spreading into these last areas and/or involvement of the hands and face in non-occupational ACD can be observed.
- The most frequent allergens are **textile dyes** and **textile finish resins**.

- **Textile dyes** are causes of **acute dermatitis** with rapid onset.
- Among textile dyes, **disperse dyes** are considered the most responsible. Literature data report their **prevalence** of sensitisation ranging between **3.1%** and **5.2%**. In particular, **disperse blue dyes** were recently selected as "contact allergens of the year" for 2000 .
- Patch tests with disperse dyes performed on children with suspected ACD and/or atopic dermatitis have shown a positivity of **4,6%**: the most common sensitizer was **Disperse Yellow 3**.



Angelini G, Vena GA. Dermatite da contatto con capi di abbigliamento. Dermatologia Professionale e Ambientale.



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- **Formaldehyde resins** produce a more **chronic dermatitis**.
- The frequency of textile-formaldehyde resin dermatitis has been reported to be between **1,2%** and **4,2%**.

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# Allergens

- **TEXTILE DYES**
- Sensitization to textile dyes in clothing necessitates a transfer of the dye from the garment to the skin. It occurs from the **dye itself**, from **intermediate products** during the dying process or after treatments, or from **metabolites** arising in the skin.
- Two principal **classifications** of textile dyes are recognized: a **chemical one** and a **use category or application class**, based on the procedure involved in applying dyes to textiles.

- By **chemical class**, the dyes most likely to cause ACD are the azoics, anthraquinones, indigoids, insoluble azoics, stilbenes and triphenylmethanes.
- Among the **application classes**, the most common sensitizers are **disperse dyes**.

- **Disperse dyes** are only partially soluble in water. The most representative chemical group of this class are the *azoic* and *anthraquinone* ones, which are suspended by dispersing agents to **synthetic fibers** such as **polyester**, **acetate** and sometimes **nylon fibers**. These dyes loosely hold onto the fibers are easily rubbed off.

- **Azo disperse dyes** are divided into 4 **chemical classes**:
- **thiazol-azoly-PPD** group (including Disperse Blue 106 and 124),
- **aminoazobenzene** group (Disperse Red 1 and 17, Disperse Brown 1 and 2),
- **PPD** group (PPD and Disperse Orange 3),
- **benzothiazol-azoly-PPD** group.



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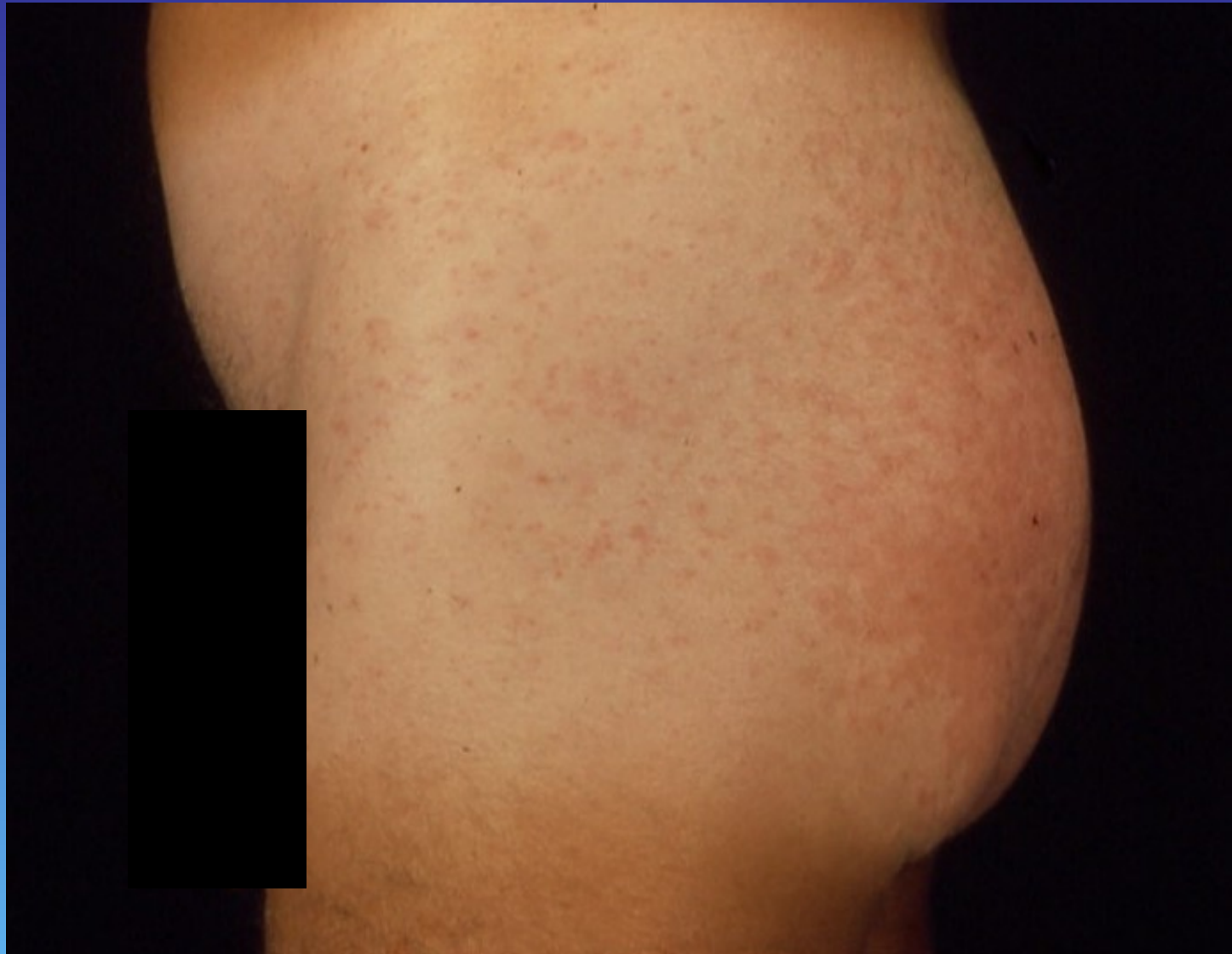
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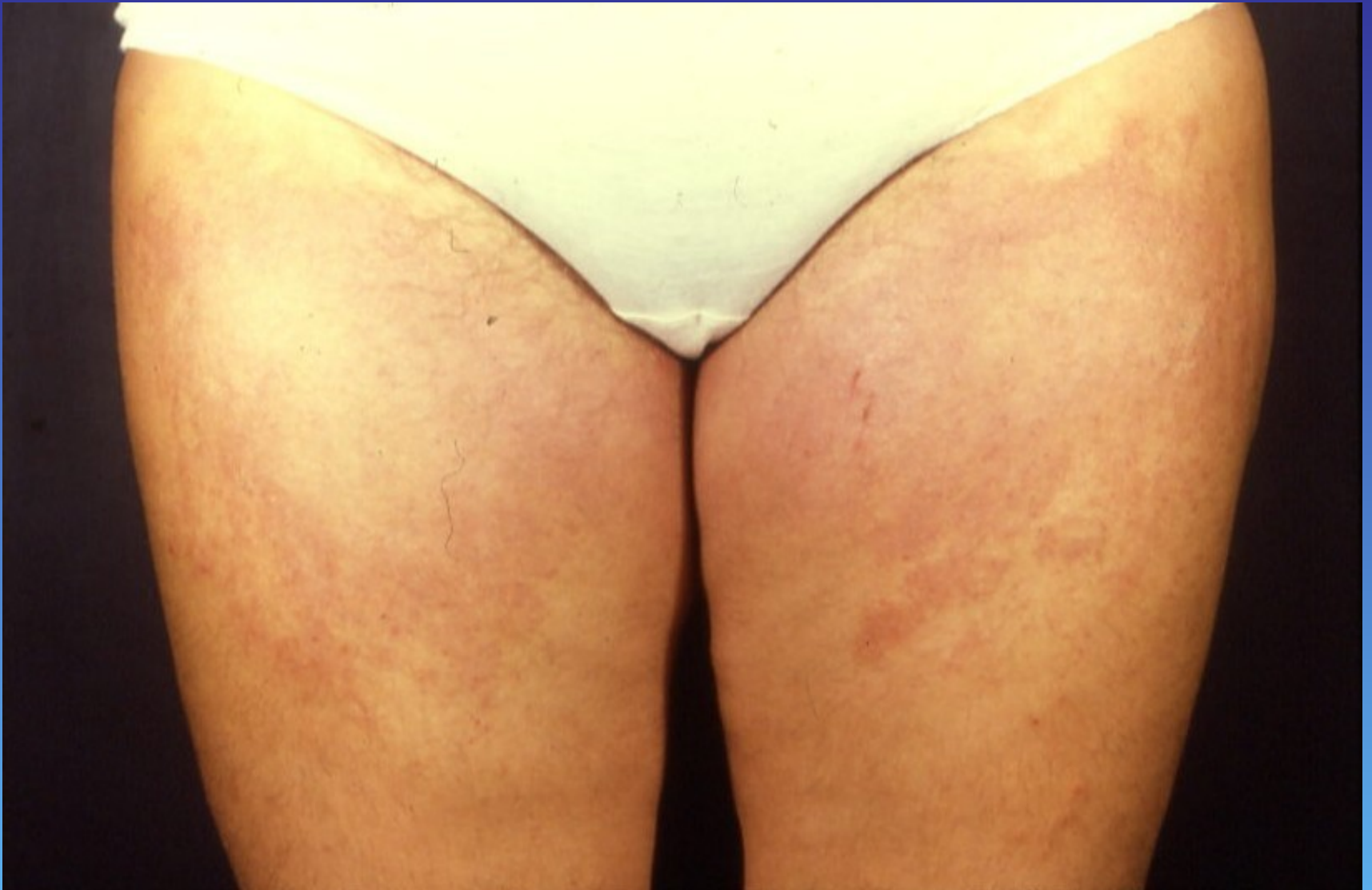
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- The **basic dyes** are the next most common **allergens**. They are mainly used to dye **wool, silk, cotton cellulose**s and polyacrylonitriles. **Basic Red 46, Basic Brown 1, Basic Black 1, Brilliant Green and Turquoise** have been reported to cause textile dermatitis.
- **Acid dyes**, also indicated as textile **allergens**, colour **wool**, other protein fibers and some man-made fibers (**nylon**). They include *monoazoic, diazoic, triphenylmethane* and *antraquinone* compounds. **Acid Yellow 23, Supramine Yellow and Red and Acid Violet 17** belong to this class.

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- **Direct dyes** are directly applied on fibers, most often **wool, cotton**, flax and leather. **Direct Black 38**, a *triazolic compound dye*, has been reported to be an **allergen**.
- **Vat dyes** are water-insoluble dyes applied in a reduced soluble form and then reoxidized to the original insoluble form once absorbed into the fibre. They are used for **cellulosics** and some **wool** principally. *Anthraquinone* or *indigoids* are the chemical groups used. Vat dyes are relatively hypoallergenic although **Vat Green 1**, an anthraquinone derivative, has been reported to cause five cases of **contact dermatitis** from blue uniforms in nurses.



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- **Reactive dyes** consist of a direct colourant, with an *azo* or *anthraquinone* structure or *phthalocyanin* derivative group, connected to a reactive group, capable of linking through covalent bonds to amine or sulfhydryl groups of proteins. These dyes are used for coloring **natural fibers** as cotton, silk and wool and are also applied for **polyamides**. **Asthma** and **contact dermatitis** have been described after occupational exposure to reactive dyes.

- A study conducted on 1813 subjects patch tested with 12 reactive dyes has revealed 18 patients sensitised to these dyes. Most of them showed dermatitis localized to the trunk, upper limbs and/or hands; only one patient, occupationally exposed, presented the dermatitis localized to the face. The dyes most frequently responsible for positive patch tests were Red Cibacron CR (Reactive Red 238) and Violet Remazol 5R (Reactive Violet 5). A further study performed with 5 other reactive dyes patch tested on 312 patients showed no positive allergic or irritant reactions.



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- **Sulfur dyes** are used for **cotton**, particularly for black colors and work clothes.
- Among *dyes synthesized in the fiber*, **insoluble azoics**, frequently used in underdeveloped countries, are included. They are applied for **cellulosics** and **polyesters**. A coupling component, e.g. *Naphthol AS (3,hydroxide-2, naph-thanilide)* plus a *diazonium salt* or *diazo compound* form dye in the fiber. Coupling agents have caused **pigmented contact dermatitis**.

- **Oxidation Base Dyes**, sometimes used for **cotton**, although generally used for **fur** and hair, are constituted by *aromatic amines, diamines and aminophenols oxidized with hydrogen peroxide*.
- This group also comprehends the **phthalogens**, which are represented by *phthalocyanin dyes*.

- *Pigments*, used in textile printing, differ from dyes because they have no fiber affinity and are held to fabric with a resin binder (e.g. glue, methacrylate, polyvinyl condensates). Pigments include *azoics*, *anthraquinones*, *phthalocyanins*, *indigoids* and *triphenylmethane*.

# TEXTILE RESINS

- Textile finish resins (TFR) have been used since the 1920s to impart wrinkle resistance during wear and laundering to fabrics.
- They are widely applied on cotton, cotton/polyester or wrinkle-resistant linen, for which they facilitate bleaching and dyeing.
- TFR can also ameliorate nylon and make it electrically antistatic.
- Other qualities of TRF are expressed by their capabilities of improving fabric touch and appearance and rendering it waterproof, non-shrinkable and mothproof.

- Two major types of durable-press resins have been developed for textile industry:
- formaldehyde based resins (older)
- cyclized urea derivatives (more recent).
- Most TRF **release** variable amounts of **formaldehyde**, that is considered one of the major cause of textile contact allergy.

Formaldehyde based resins include:

- urea formaldehyde (dimethylol urea) resins
- melamine-formaldehyde resins

## Cyclized urea derivatives

- They represent the current TRF at the moment.
- These numerous molecules mainly include:
  - dimethylol ethylene urea (DMEU),
  - dimethylol dihydroxy ethylene urea (DMDHEU),
  - dimethylol propylene urea (DMPU),
  - dimethylol dihydroxy propylene urea (DMDHPU).

- Such resins release various amounts of free formaldehyde.
- In the 1960s, many textile manufacturers moved to the use of dimethylol-dihydroxy ethylene urea (DMDHEU) which yielded fabrics with approximately 500 ppm free formaldehyde.

- Other durable-press resins:
- **dihydroxy dimethyl-imidazolidinone (DHDMI)**, that apparently do not release free formaldehyde.
- **carbamate derivatives**, especially used for mixed cotton-polyester, which release moderate amounts of formaldehyde.
- **polycarboxylic acid systems**, such as butane tetracarboxylic acid (BTCA), citric acid or modified polycarboxylic acids.
- Also, the following chemicals may occasionally be used to develop durable-press finishes for textiles: polymeric acetates, silicone polymers, triazones, methylol dimethylhydantoin, epoxide resins, chloro-alkyl cross-linkers, chloromethyl ethers of polyhydric alcohols, divinyl sulfone derivatives and tris (beta sulfato-ethyl) sulfonium salt.

## Clinical features

In its early stage, **textile resin-related ACD** appears as a pruritic, papulovesicular, erythematous eruption that may subsequently become chronic and lichenified. It is generally located in the areas covered by clothing, with particular interest of the axillary folds in women and of the neck in men; anyway, a diffuse distribution is often described, that could at times presents with a generalized **erythroderma**. The involvement of the hands is frequently related to occupational ACD, but hands and face may also be interested because of a possible cross-reaction with formalin releasing preservatives used in cosmetics.