

**HANDLE WITH CARE**

Possibilities of Safeguard, Remediation and  
Decontamination  
of Objects in Museum Collections



Foto: William R. Goodwin

Preventive Methods

Safeguard

Protection

Refurbishment

Decontamination



# Preventive Methods

## Facilities





# Preventive Methods

## Furnishings



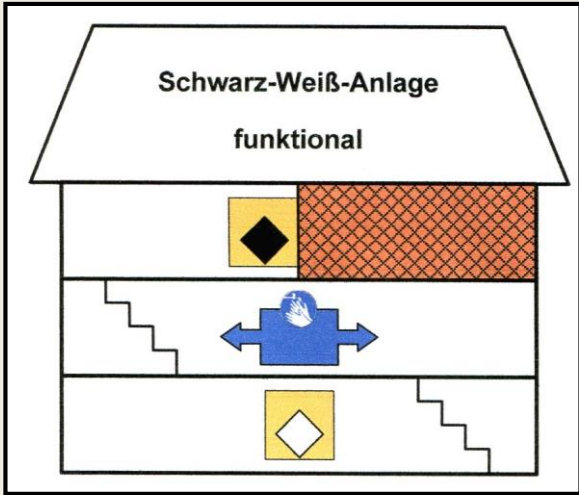
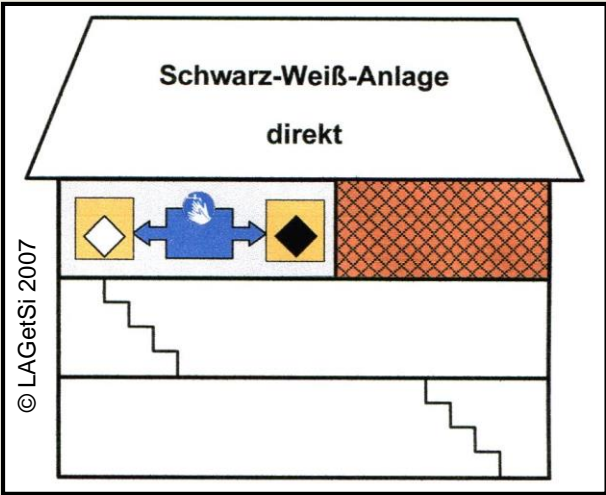
# Preventive Methods

## Storing Objects





# Safeguard



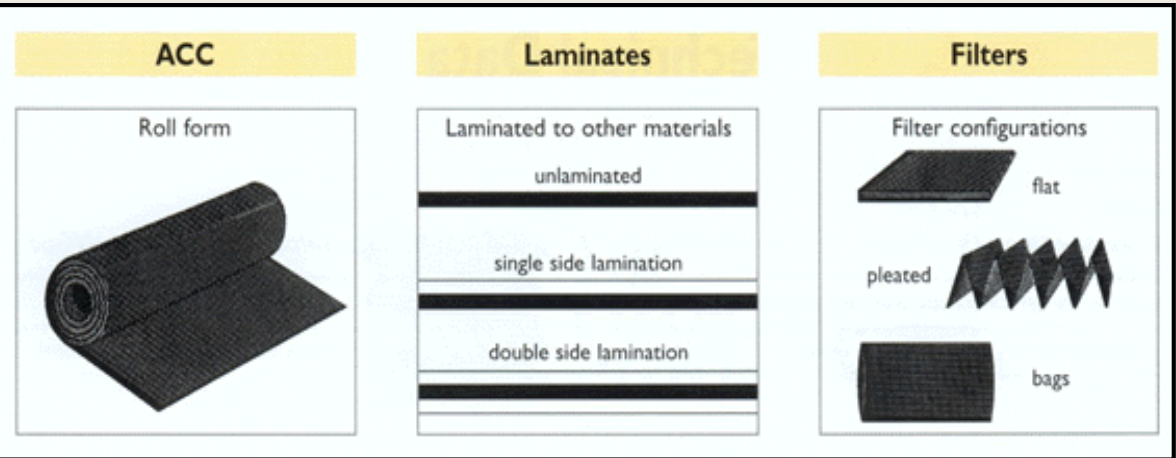
# Safeguard



# Protection



Foto: Graham Martin



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# Protection



Foto: Carola Klinzmann



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# Refurbishment

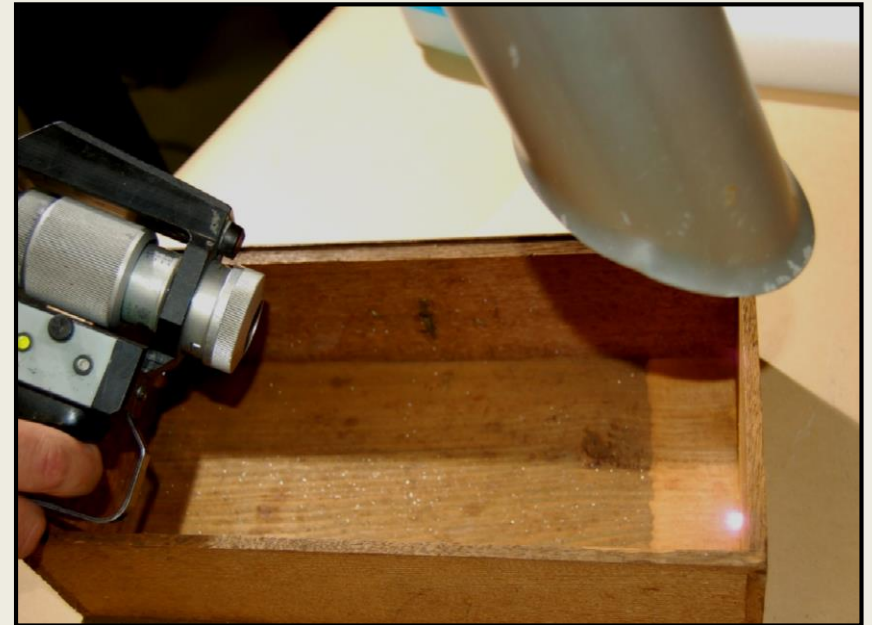


Foto: Achim Unger



Foto: Roberto Fortuna, The National Museum of Denmark

# Methods and Technologies of Decontamination



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# Methods and Technologies of Decontamination



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# Methods and Technologies of Decontamination



Fotos: Carola Klinzmann

# Methods and Technologies of Decontamination



Fotos: Sabrina Zoppke

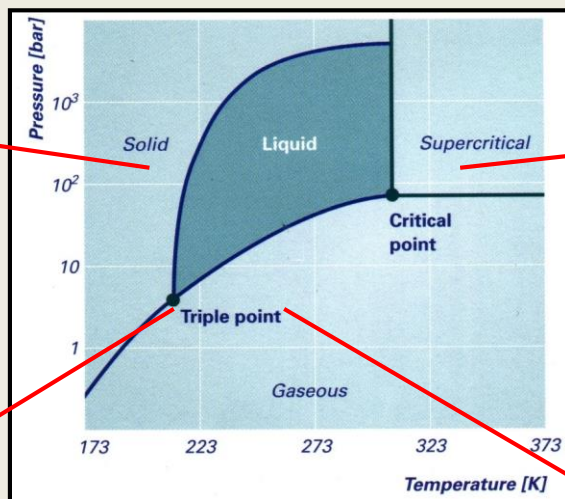


# Methods and Technologies of Decontamination

## Carbon Dioxide



Surface cleaning



Decontamination

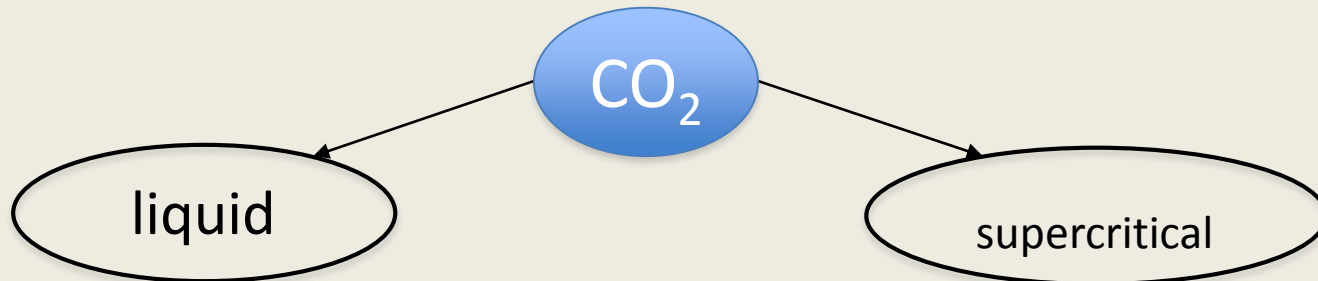


Degreasing



Fumigation

# Methods and Technologies of Decontamination



- Temperature: 15-20° C
- Pressure: 40 – 55 bar
- Ability of cleaning (kb-kauri butanol value) same as for hydrocarbons
- Low surface tension, and so good wetting
- Low viscosity, and so good wetting
- Minimal solubility of water in liquid CO<sub>2</sub>.
- Adding of detergent for removing water soluble dirt necessary

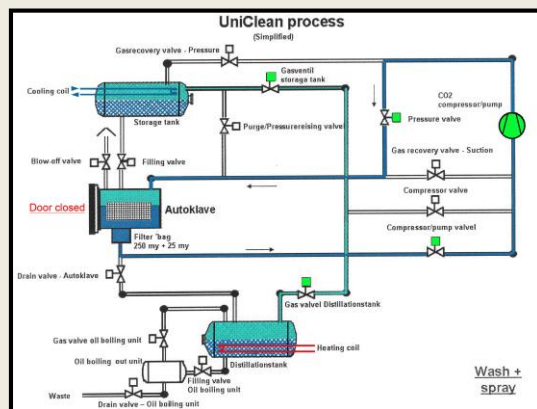
- Low critical point (+ 31° C; 73.8 bar)
- Gas-like low viscosities
- High diffusivity
- Very low surface tension
- Liquid-like densities
- Good solvent for non polar organic compounds
- Rapid and complete penetration of semi-porous medias
- minimal toxicity

# Methods and Technologies of Decontamination

## Liquid Carbon Dioxide



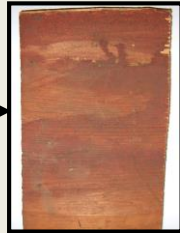
Fotos: Achim Unger



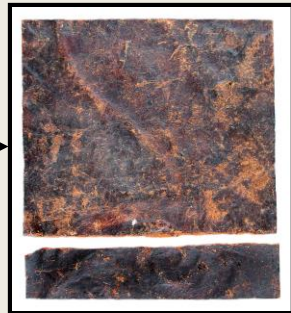


# Methods and Technologies of Decontamination

## Results



- DDT- Reduction: approx. 90 %
- Remarkable cleaning effect
- Paint layer intact, no cracks resulting from tension

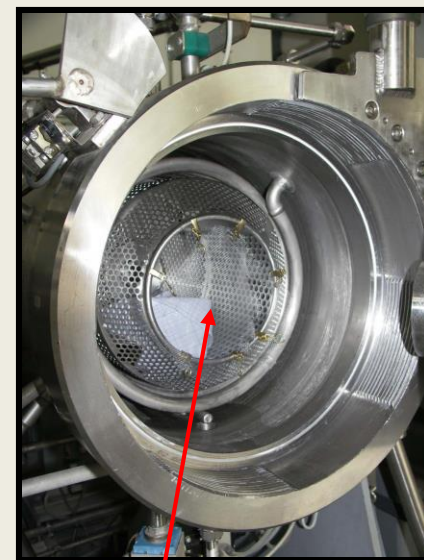
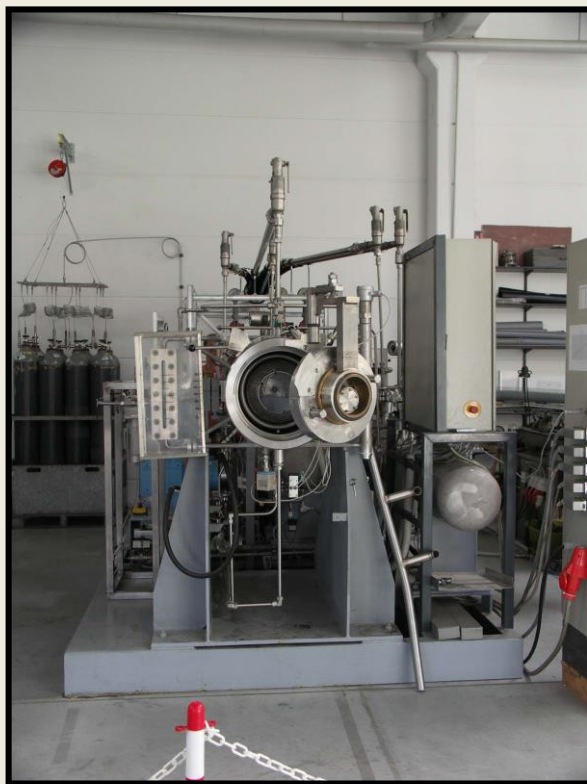
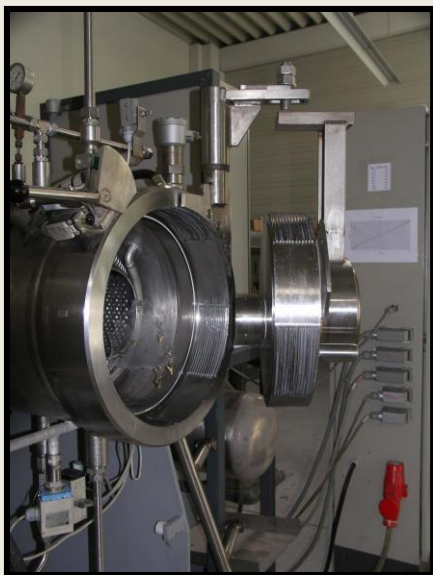


- Over lubricated leather tapestry is degreased
- Material stays smooth
- No flaking of colored stamping



- DDT- Reduction: approx. 90 %
- Removal of oily and fatty substances
- No bleeding of dyes

# Methods and Technologies of Decontamination

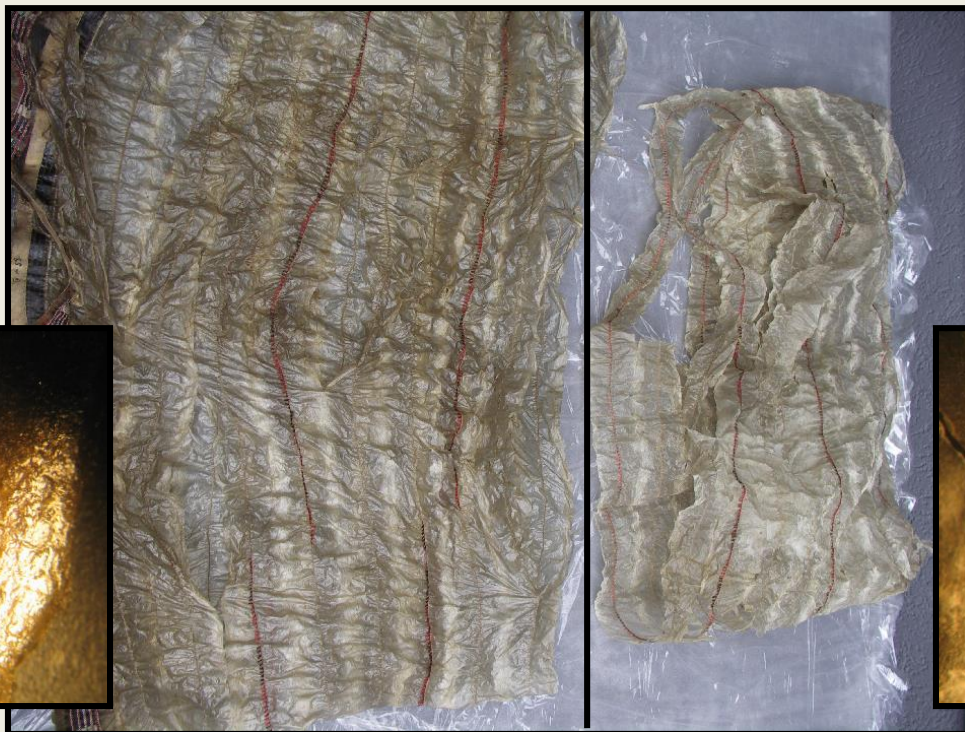


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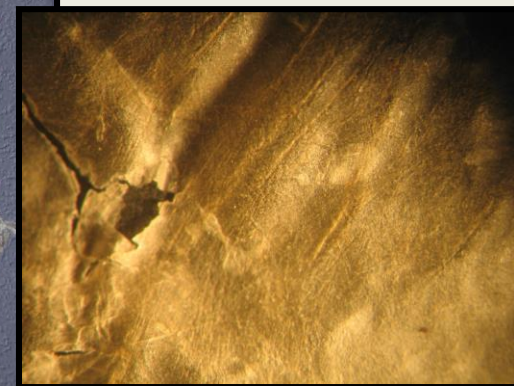
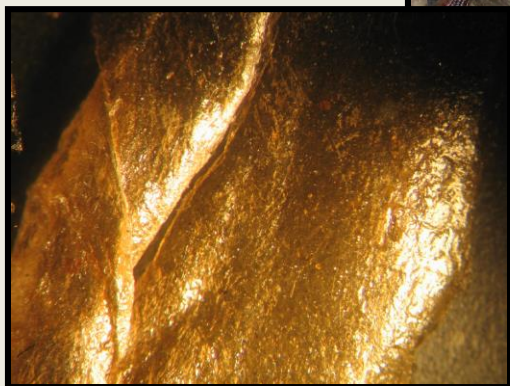
# Methods and Technologies of Decontamination

## Results

before



after



Seal gut parka of the Inuit from the Ethnological Museum in Berlin

Decontamination rate for DDT, Pentachlorophenol and Lindane: 88.0; 75.0; 70.6 %  
for As- and Hg-Compounds: **Zero (!)**



# Methods and Technologies of Decontamination

## Results

before



after



Woolen blanket from Patagonia of the Ethnological Museum in Berlin

**Decontamination rate for DDT, Arsenic and Mercury: 71.3; 50.0; 45.8 %**

**Lindane and Pentachlorophenol were not contained**

# Methods and Technologies of Decontamination



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# Methods and Technologies of Decontamination

## Results



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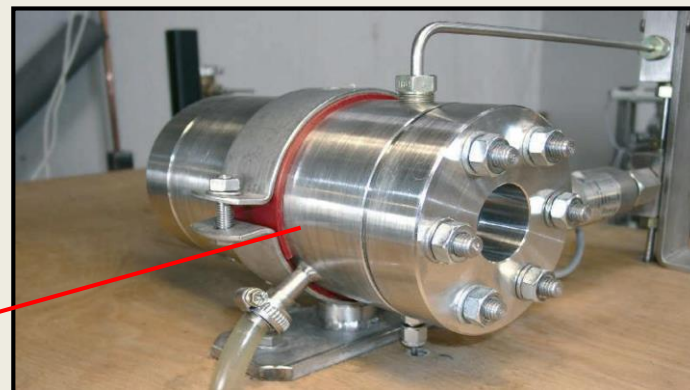


# Methods and Technologies of Decontamination

## Supercritical Carbon Dioxide

### Process Parameters

Parameter	Plant	
	150 mL	10L
Operating pressure (bar)	350	250
Operating temperature (° C)	40	40
Duration of extraction (h)	7	3
CO <sub>2</sub> -flow rate (kg/h)	2	20



# Methods and Technologies of Decontamination

## Process Parameters

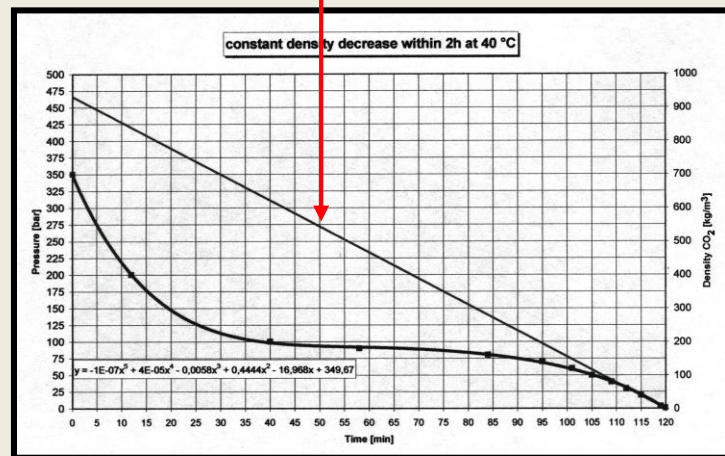
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Critical phases and technological steps

(These are essential for full-plastic objects)

pressure build-up phase  
pressure release (venting) phase

depressurization with constant density decrease



co-solvents/modifier:

ethanol, trimercaptotriazine (TMT15)

# Methods and Technologies of Decontamination

Selected Materials and Objects for Experiment at the 150 mL Laboratory Plant

Main Constituents	Materials	Objects
Cellulose	Tissue (cotton)	
Cellulose, Hemicelluloses, Lignin	Tapa (Birchbark)	
Proteins	Tissue (wool), Bundle of Feathers	
Proteins, Fats	Raw Hide, Fur	
Mixed materials, mainly organic		Mixed object (leather, hair, cotton, wood)





# Methods and Technologies of Decontamination

Selected Materials and Objects for Experiment in the 10L plant

Main Constituents	Materials	Objects
Cellulose, Hemicelluloses, Lignin	Blades of Grass	
Proteins, mainly	Horsetail hair	
Proteins, Fats	Caribou fur	
Mixed materials, mainly organic		Calabash with beads, string, wax (adhesive)
Mixed materials, mainly inorganic		Ceramic tile bonded with animal glue



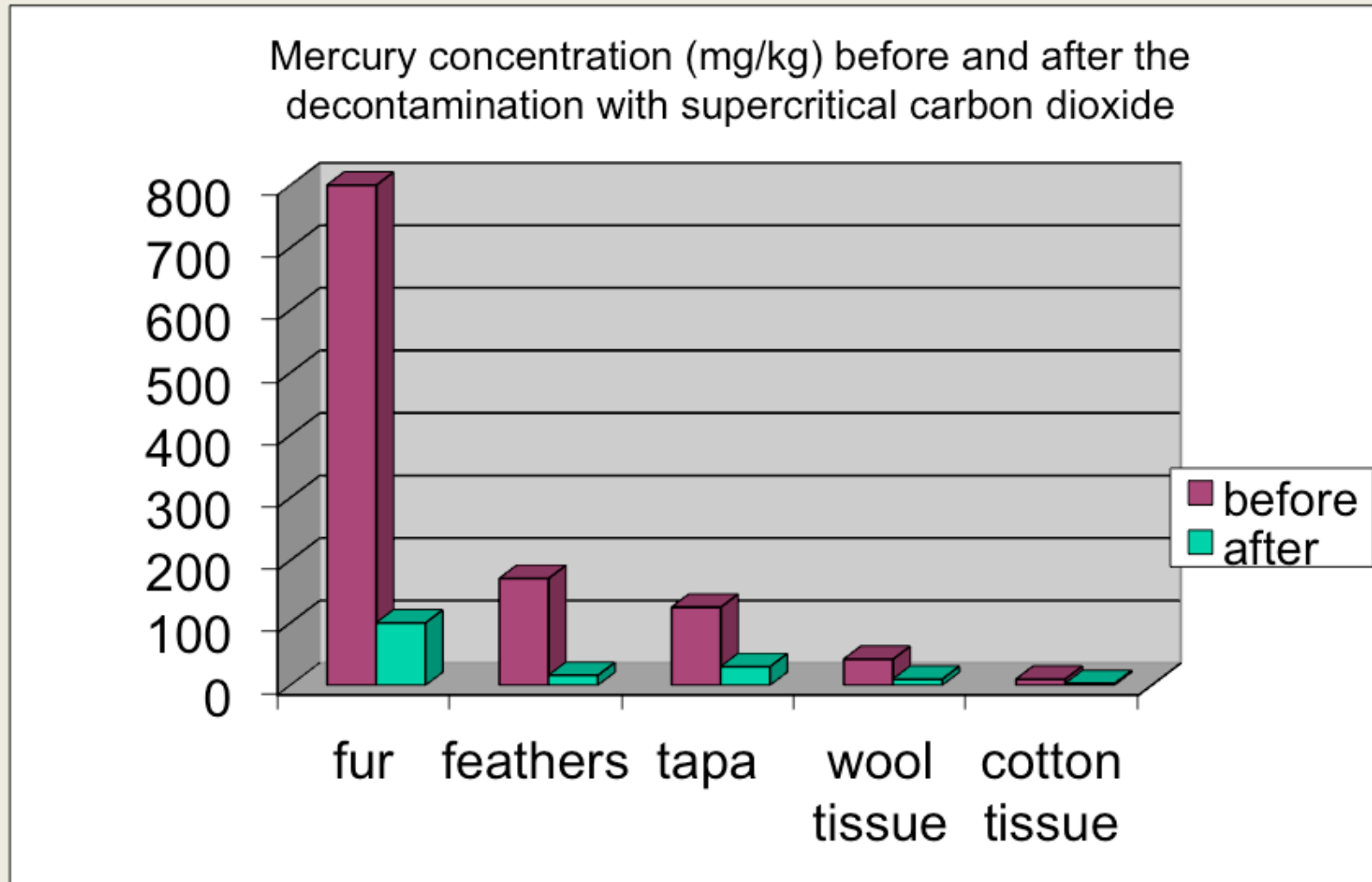
# Methods and Technologies of Decontamination

## Decontamination rates

Object/Material	Decontamination rate (%)				
	As	Hg	DDT	Lindane	PCP
fur	37.5	87.5	94.9	83.3	n.d.
bundle of feathers	no ef	90.6	99.5	n.d.	n.d.
tapa	no ef	76.0	80.7	62.5	n.d.
raw hide	no ef	n.d.	16.7	n.d.	50.0
mixed object (leather, hair, cotton, wood)	no ef	62.5	n.d.	n.d.	50.0
wool tissue	no ef	76.2	n.d.	n.d.	25.0
cotton tissue	no ef	70.0	98.1	66.7	25.0
mean value	(37.5)	(77.2)	(78.0)	(70.8)	(37.5)

legend: no ef = no effect    n.d. = not determined

# Methods and Technologies of Decontamination





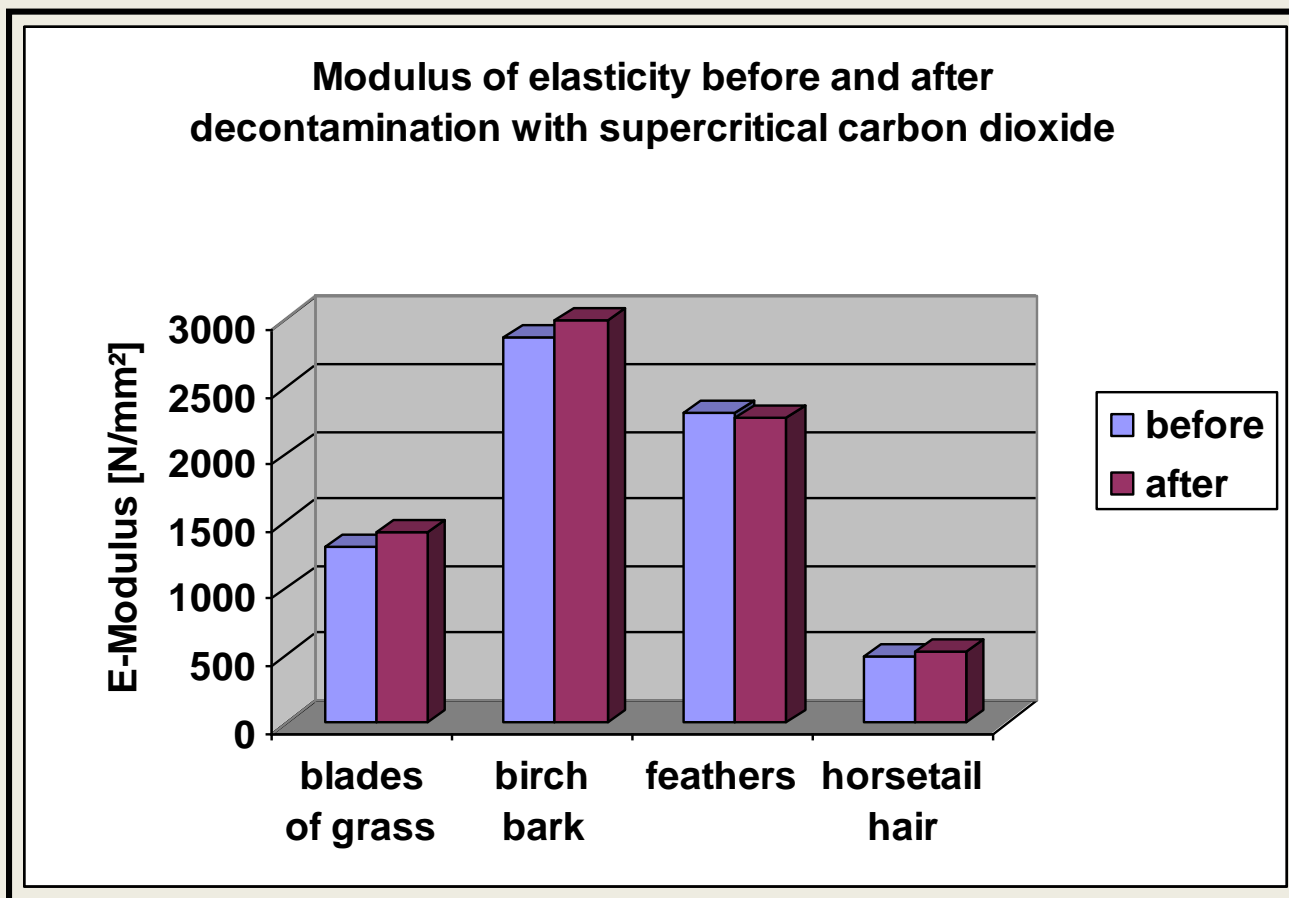
# Methods and Technologies of Decontamination

## Impact on Properties of Materials and Objects

Objects/materials	Cleaning effect	Loss of ingredients (mainly degreasing)
blades of grass	+++	-
calabash	+++	-
caribou fur	+	++
horsetail hair	-	-
ceramic tile	-	-
bonded with animal glue	-	-

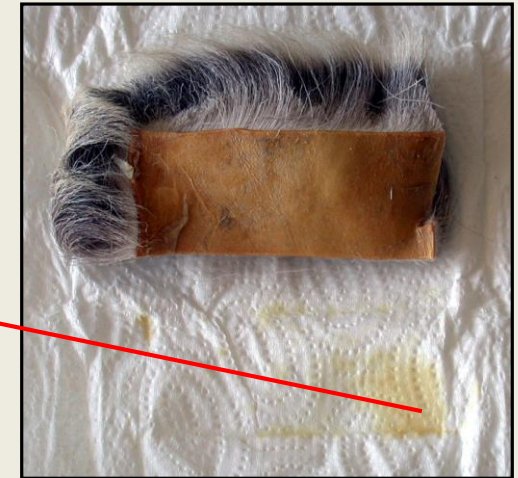
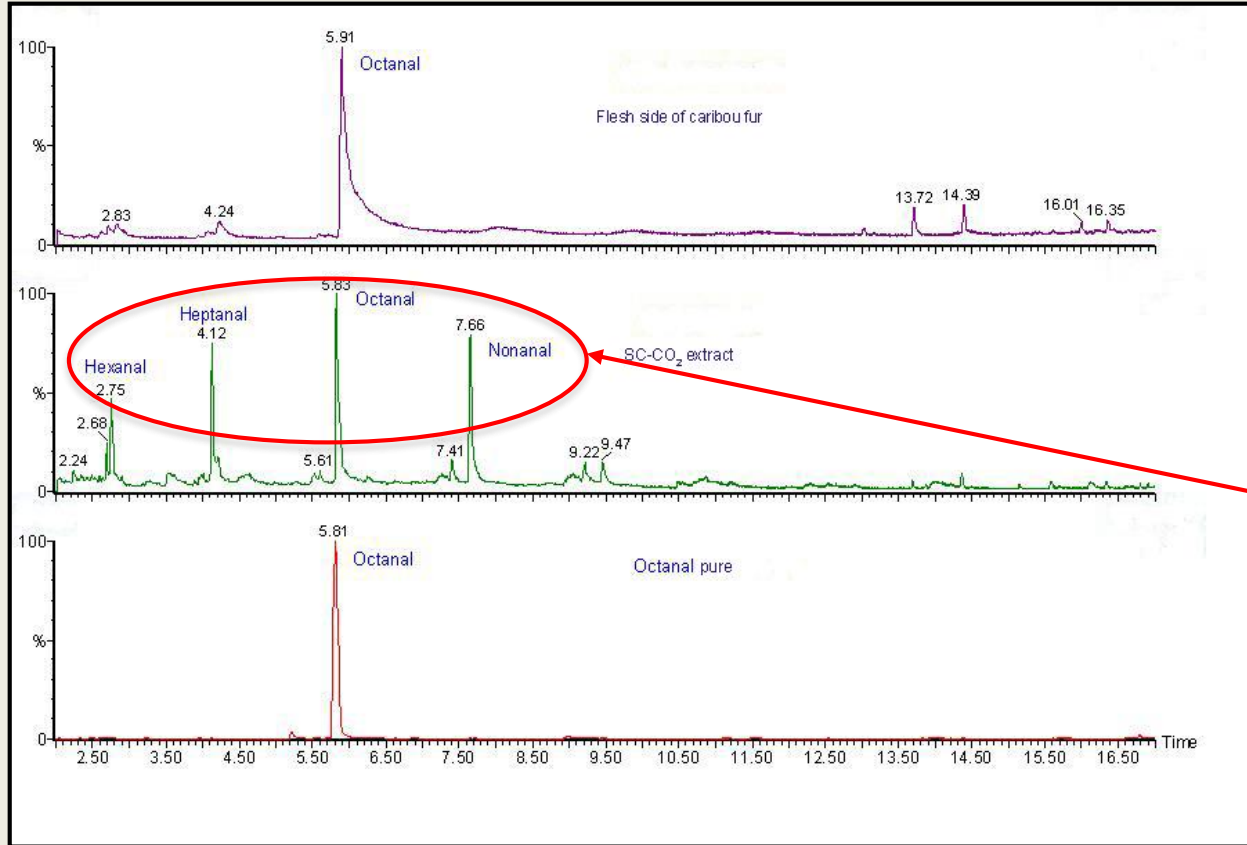
legend: +++ = strong      ++ = normal      + = poor      (+) = very poor  
- = no loss of ingredients

# Methods and Technologies of Decontamination



**T-Test: No significant change by the treatment**

# Methods and Technologies of Decontamination





# Conclusion and Outlook

Pesticides are a worldwide problem

They emit from the matrix of objects

Handling objects is restricted

Removing of contaminated dust

Health Hazard

Protective clothing is unavoidable

More research in remediation and decontamination

