



How to promote substitution effectively – practical lessons from case studies

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Structure of the lecture

- **LEGAL FRAMEWORK**
- **POOR INDUSTRY RESPONSE**
- **BARRIERS FOR SUBSTITUTION**
- **DRIVERS FOR SUBSTITUTION**
- **CASE STUDIES**
- **CONCLUSIONS**
- **ANNEXES**



Legal Framework

Legal Framework

EU-Directives, demanding substitution as priority

- **General substitution regulations (without a substance list):**
IPPC, CAD, VOC-Directive, Waste directive
- **General substitution regulations (with a substance list):** Water Frame Directive
- **Detailed bans for certain substances:**
End-of-life-vehicles, VOC (for carcinogenic substances), Carcinogenic Substances Dir etc.
- **Biocide Directive:**
Detailed substitution procedure
- **REACH**

Legal frame of substitution

■ Substitution in EU as first priority

STOP-system = Substitution, Technology, Organisation, Personal protection

EU: Council Directive 98/24/EC on the protection of the H&S of workers from the risks related to chem. agents at work

Article 6 (1): The employer shall ensure that the risk from a hazardous chemical agent to the safety and health of workers at work is eliminated or reduced to a minimum.

(2) In applying paragraph 1, **substitution shall by preference be undertaken**, whereby the employer shall avoid the use of a hazardous chemical agent by replacing it with a chemical agent or process which, under its condition of use, is not hazardous or less hazardous to workers' safety and health ...

Legal frame of substitution

Substitution of biocides is obligatory, whenever there is a less hazardous alternative

EU: DIRECTIVE 98/8/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 February 1998 concerning the placing of biocidal products on the market

Article 10, 5 (i) V:

An entry of an active substance in Annex I and, where relevant, IA or IB may be refused or removed,

- if the evaluation of the active substance in accordance with Article 11(2) shows that, under normal conditions under which it may be used in authorised biocidal products, risks to health or the environment still give rise to concern, and
- if there is another active substance on Annex I for the same product type which, in the light of scientific or technical knowledge, presents significantly less risk to health or to the environment.

Legal frame of substitution

REACH – Substitution Regulation

Existing substitutes – application for authorisations*

“If there are (suitable alternative substances or technologies), they must prepare substitution plans, if not, they should provide information on research and development activities, if appropriate.” *
(ref. to § 62 (4f))

Future Substitutes

“The Commission may amend or withdraw any authorisation on review if suitable substitutes become available.” *
(ref. to § 61 (2))

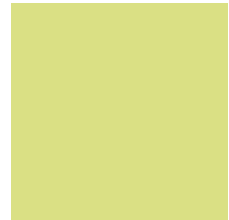
*Quoted from ‘REACH in brief’

National legal frame of substitution

The same legislation in many more Member States of the EU here Germany Substitution as first priority

Germany: Ordinance on Hazardous Substances, 1986 version

§16, Para. 2: The employer must check whether substances, preparations or products with a lower health risk than those he intends to introduce are available. **If it is reasonable for him to use such substances, preparations or products and if substitution is necessary to protect the life and health of employees, only they may be used.**



Poor industry response



Deficits of substitution in practice

Most enterprises do not follow the most simple rules

HSE UK:

“In approximately 1.3 million British companies chemicals are handled. When questioned, **only 16%** of these companies were able to state the applicable law for handling chemicals or the limit values for these substances at the workplace.”

Ministry of Social Affairs – State of Hesse

Between 60 and 70 % **do not (or cannot) observe** the statutory requirements of chemicals regulation: instructions of employees, lists of dangerous substances, documentation of the substitution assessment



Barriers for Substitution

Main factors not to substitute

Uncertainty and 'Never change a running process'

- Neither a priority in enterprises nor in practical governance
Dealing with current problems is already too laborious
No additional problems by an unnecessary innovative approach
(existing standards etc.)
- Uncertainty in risk assessment – shift of risks
- Substitutes have been less tested in practice
- Integration in the production chain makes an innovation beyond enterprise borders necessary
- Technological or economic difficulties

Major **NON-Substitution**-strategies for risk reduction

-  **Reduction and elimination of emissions**
Technology, hygiene, organisation
-  **Protection of target media**
Air soil, water, workers, consumers
-  **Reduction of the concentration of a hazardous substance**
Dilution, ventilation, non functional filler materials

Advantages of these strategies

Quantifiable, measurable,
From one point to another on one path.
Substitution is an exception.

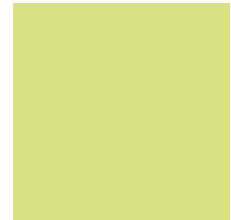


Drivers for Substitution

Main factors to substitute:

Guiding principles and market forces

- **Target oriented:** Health, Environment, Nature
- **Substance oriented** (general approach):
Water based, biodegradable, clean, pure ...
- **Substance oriented** (scientific approach):
Lowest toxic effect for humans and environment
- **Legal approach:** Not labelled as dangerous
- **No scandal substances** (marketing driven):
No asbestos, no heavy metals, no PCBs, no TBT, no ...



Case Studies

Some case studies EU-Level

<i>Case study [by application]</i>	<i>Problematic Substance(s)</i>
1 Metal parts cleaning	Organohalogen solvents
2 Cleaning of façades	Strong acids, alkalis, solvents and detergents
3 Textile dry-cleaning	Perchloroethylene
4 Marine anti-fouling	Organotin compounds
5 Wood preservation	PCP and lindane
6 Flame retardants in circuit boards	Brominated flame retardants
7 Loss lubrication in inland water ships and locks	Lubricants derived from mineral oil
8 Mould-release agents	Mineral-oil based agents
9 Rechargeable batteries	NiCd accumulators
10 Plasticisers in toys	Phthalates in PVC

Some case studies Germany

<i>Field of application</i>	<i>Conventional chemical</i>	<i>Compared Substitute/process</i>
Automotive series coatings	High solvent coatings	Low solvent coatings
Softeners in plastics	DEHP	DINP or DIDP
Mould releases (concrete separating agents)	Petrochemical products	Esters based on renewable vegetable oils
Fibres in automotive silencers	Conventional man-made mineral fibres	Biosoluble fibres
Mineral fibres in automotive catalytic converters	Ceramic fibres	Biodegradable fibres
Cutting fluids	Petrochemical oils and biocidal additives	Minimum quantity cooling lubrication
Industrial cleaning of metal surfaces	Water-based cleaners	Organo-halogen solvents
Cement	Chromate cement	Cement with additives to reduce skin diseases
Stripping agents	Methylene dichloride	MDC-free stripping agents
Printing inks in packaging printing	Solvents	UV-drying

Cases: Influence factors

■ Material costs, Capital expenditures, Investment costs, Energy costs
Labour costs, Organisational costs, Insurance costs

Technical protective measures, Ventilation measures, Fire/explosion protection, Personal protective measures, Occupational health precautions, Workplace measurements

Transport costs, Freight tariffs, packaging ...

Storage costs, Disposal costs, Recycling, Waste water, Exhaust air

Further influential factors as:

Company-related factors as corporate image, satisfaction of personnel, sustainability/planning reliability

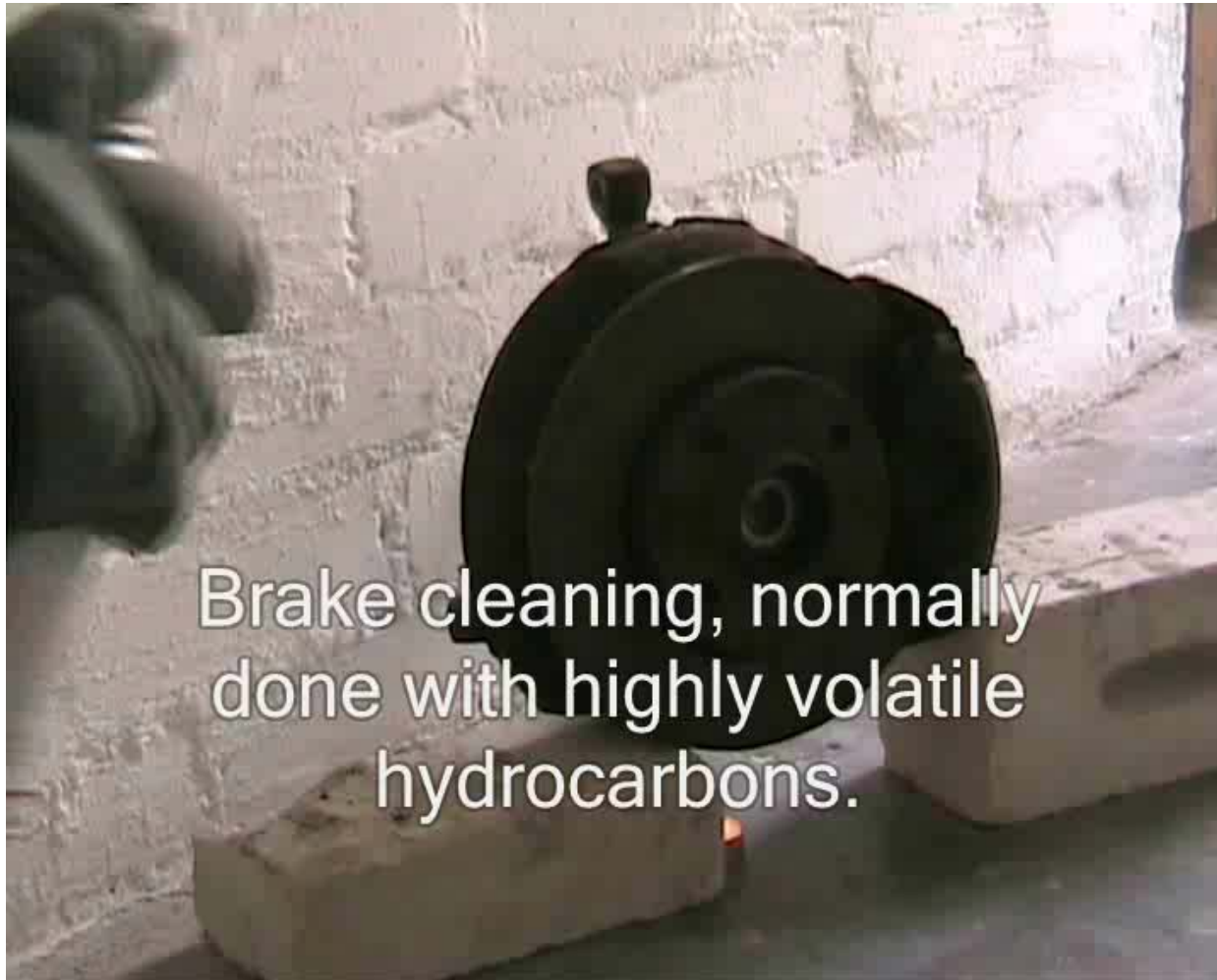
Case 1: Cleaning of car brakes Arguments for and against substitution



Case 1: Cleaning of car brakes – pressurised air



Case 1: Cleaning of car brakes – the risk with VOCs



Case 1: Cleaning of car brakes – alternative technique: hot water



Case 1: Cleaning of car brakes

Actors and arguments pro and contra substitution

ACTORS	ARGUMENTS
Cleaning equipment producers	Effectivity, safety, innovation
Work accident insurers	Safety, compliance
Environmental and OSH authorities	Safety, compliance
Workers (perhaps)	Fewer health risks

ACTORS	ARGUMENTS
Owners of car repair workshops	Cost of equipment
Owners of car repair workshops	Speed of work
Environm. and OSH authorities	Safety and env. protection
Workers	User convenience

Case 1: Cleaning of brakes

Actors of substitution

Halogenated solvents vs. high pressurised water

Substitution **ADVOCATES**

Cleaning equipment producers
Accident insurers
Environmental and OSH authorities
OSH personnel dealing with chemicals
Workers: Safety and Health

Actors **CONTRA** substitution

Owners of cleaning enterprises due to cost of equipment
Owners of buildings (damage to façades)
Cultural heritage authorities (damages of the façade)
Construction authorities (standards)
OSH personnel dealing with accidents (risk due to high pressure)
Workers: Convenience

Case 2

Costs and quality

Biodegradable loss lubricants (BLL) in inland and coastal water activities

■ **Priority of state owned water
authorities:**

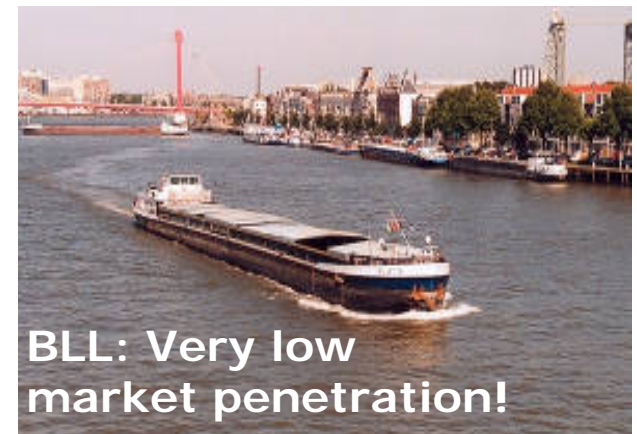
Water protection
Long lasting – high quality

■ **Priority:**

Price
Sufficient quality
Short term functioning
Water protection? – No legal obligation!



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Conclusions

MAIN SUBSTITUTION STRATEGIES

Substitution Type 1:

Replace hazardous substance by a less hazardous substance while maintaining technology/product functionality

Substitution Type 2:

Use a less hazardous or non-chemical solution by changing the technology/product functionality

Substitution Type 3:

Use a less hazardous or non-chemical solution by changing the work organisation/product use pattern

Substitution – Technological feasibility

There is no simple 'Yes' or 'No' – Options are:

- Better – than the conventionally used chemical
- Equal ...
- Better in certain applications – worse in others
- Equal in certain applications – worse in others ...
- Worse ...

Types of substitution problems, regulatory options and possible results

<i>Efforts dep. on the type of the substitution problem</i>	<i>Regulatory Option In general / under REACH</i>	<i>Intended result</i>
1. Open innovative and demanding technological questions: R&D	Support, incentives, research; REACH – 6 years time limited authorisation	Development of a new preparation or of a completely redesigned process
2. Adaptation of existing technologies necessary: DEVELOPMENT	Mixtures of incentives and command-and-control; REACH: detailed substitution plan and time limit	Adaptation of processes Medium-Term implementation
3. Implementation of reference processes that are already widespread: INFORMATION	Substitution must be applied – exceptions only for certain applications	Introduction of a solution that has undergone practical testing



Annexes

- **References**
- **Projects**
- **History of substitution of chlorinated solvents**



Kooperationstelle Hamburg - Weblinks

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