Supporting Green Entrepreneurs for a POPs Free Mediterranean

Training on:

Green Entrepreneurship & Hazardous Chemicals Substitution Process

Algiers, 18th – 19th Nov 2014

UNEP MAP Regional Activity Centre for Sustainable Consumption and Production

Stockholm Convention on persistent organic pollutants (POPs)

Content

- ✓ Module 1: The substitution process
  The material substitution in practice
- ✓ Module 2: Green entrepreneurship & free toxic chemicals
  PAXYMER (The business case)
- ✓ Module 3: Identification of chemicals of high concern
- ✓ Module 4: How and where to identify alternatives
- ✓ Module 5: POPs' substitution and safe work procedures
- ✓ Module 6: Alternatives assessment
- ✓ Module 7: Cost assessment

Module 1: The substitution process

- ✓ The importance of substitution
- ✓ SUBSPORT portal presentation
- ✓ Training method
- ✓ Definition of substitution
- ✓ Drivers for substitution
- ✓ Stakeholders in substitution
- ✓ Substitution steps

Sara Perez Díaz,
ISTAS' chemical expert

The importance of substitution

- ✓ Hazardous substances are present in most of the companies and workplaces
- ✓ The most effective way to avoid human health risks and environmental risks is to eliminate the use of hazardous substances
- ✓ It is possible both substitution of toxic chemicals and modify the productive process

- ✓ **Personal protection devices – the last defense line!!**

- ✓ **Personal protection devices – has a limit**

- ✓ Substitution can be a step in product innovation with positive cost/benefit for the company
- ✓ Substitution can be very easy – being a copy-cat is no shame!
- ✓ Sometimes substitution takes a lot more thinking than doing. A systematic approach is necessary. We have tools for this.
- ✓ SUBSPORT internet portal: constitutes a state-of-the-art resource on safer alternatives to the use of hazardous chemicals

SUBSPORT Portal Presentation

- ✓ Free and multilingual internet portal
- ✓ Case Story Database
  - Get inspired by others

Source: Victorinox.ch

- ✓ Restricted and Priority Substances Database
- ✓ Substitution tools (alternatives assessment…)

www.subsport.eu

Training method

- ✓ Training method is based on the Small Group Activity Method which is focused on activities
- ✓ Participants are divided in small groups to perform different tasks
- ✓ Results are shared with the other participants in plenary sessions
- ✓ Aim: learn by doing and by sharing knowledge and experience with the other participants

Module 1: Practice exercises

- ✓ Definition of substitution
- ✓ Drivers for substitution
- ✓ Stakeholders in substitution
- ✓ Substitution steps

Module 1: Practice exercises

Goals:

- ✓ Establish a common definition of substitution that will be used during the training session
- ✓ Get an overview of the substitution process
- ✓ Understand the variety of stakeholders that can influence a substitution process
- ✓ Identify main interests and drivers of participants towards substitution
- ✓ Identify participants' main training needs on the assessment of alternatives
- ✓ Understand participants' experience and interests in substitution

Tasks:

In small groups (30 min)

Read text 2.1. DEFINITIONS and discuss the shortcomings of the different definitions of substitution. Choose the best option or establish your own definition.

Read text 2.2. WHY DO WE WANT TO SUBSTITUTE? discuss your organisation's main drivers for substitution. Who do you believe are the most important stakeholders in a substitution process?

In text 2.3. THE SUBSTITUTION PROCESS (page 12) a systematic approach including seven steps is presented.

Large group (30 min)

- ✓ Each group shares their chosen definition of substitution, their main drivers for substitution and most important stakeholders in a substitution process.

Comments

Definitions

Different perception of different stakeholders about substitution:

- ✓ Industry: focus on risk not on hazard. Equivalent strategy among many others
- ✓ NGOs: Focus on hazard and systematic substitution
- ✓ Policy and legal: Combine both hazard and risk reduction
- ✓ Researchers: Achieve a functional equivalent by chemical or non chemical measures

Comments

Why do we want to substitute?

Four greatest barriers in substitution

- ✓ Not defining stakeholders and their interest
- ✓ Too narrow perspective in looking for solutions
- ✓ Not knowing where to look for new ideas
- ✓ Too narrow perspective of economy

Module 2: Green entrepreneurship & toxic-free product development

Introduction

Amit Paul,
Paxymer AB

What is the rationale for green entrepreneurship

Macro trends

✓Cheaper materials

✓Greener materials

✓Tougher regulation

✓Moving towards circular economy, zero waste, energy efficiency

✓Focus on the function of the material – what is necessary?

How are the trends reflected in the legislation?

✓ Persistence (EU definition - PBT & Stockholm convention definition - POPs)

✓ Elimination of hazardous products – increased control from official bodies

✓ Increased producer responsibility.

An un-precedent market opportunity for sustainable innovation and green entrepreneurship

Green companies were recently found to give about 5% better ROE and ROA than non sustainable comparable companies.

What to consider when approaching green chemistry? – framework by Anastas and Warner

1. Prevent waste
2. Maximize atom economy
3. Design less hazardous chemical syntheses
4. Design safer chemicals and products
5. Use safer solvents and auxiliaries
6. Increase energy efficiency
7. Use renewable feedstock
8. Avoid chemical derivatives
9. Use catalysts, not stoichiometric reagents
10. Design chemicals and products to degrade after use
11. Analyze in real time to prevent pollution
12. Minimize the potential for accidents

What to consider when approaching green chemistry/product development in practice?

- ✓ Consider function before chemistry
  - what are “need to have” properties of the product?
  - what are the basic properties of the intended chemistry?
- ✓ Consider customer processes and urgent pains
  - New EU-legislation is emphasising the precautionary principle
  - Growing producer responsibility especially for consumer markets
  - Fitting into customers buying process and current machinery will make your sales process significantly less complex
  - Make sure you understand what drives your customers demand and timeline

What to consider: Consumer markets vs Industrial markets?

Consumer markets

- ✓ More susceptible to marketing trends and buzzwords
- ✓ Higher visibility and exposure to NGO activity
- ✓ As a rule lower demands on products lifetime/performance
- ✓ Normally unable to make big, long term investments

Industrial markets

- ✓ More rigid market structures & complex processes
- ✓ Open to long term business opportunities if it meets a high demand
- ✓ Price focused
- ✓ Performance focused
- ✓ Environment and health aspects are secondary

Module 2: Paxymer Business Case

Amit Paul,

Paxymer AB

Paxymer business case: What is Paxymer?

- ✓ Halogen-free flame retardant for polyolefin plastics. Completely free from POPs, PBTs, CMR & EDC.
- ✓ Novel system designed with functional polymers give excellent processing properties and minimal effect on mechanical properties
- ✓ The flame retardant mechanism provides low smoke toxicity, low smoke, non-dripping and low heat release rate fire performance.

Paxymer business case: The history of Paxymer

Paxymer business case: Key milestones

- ✓ Filed for patent 2006
- ✓ First customer trials 2007
- ✓ Reformulation of new product 2007/08
- ✓ Investing in manufacturing capability – small scale -07. Full scale -09.
- ✓ Formed a limited company and set up sales structure 2009/10
- ✓ Recruitment of professional board 2010
- ✓ First regular customer 2011
- ✓ Launch of new generation of products 2012
- ✓ First distribution deal 2012
- ✓ Project financing for FR solution for fibers 2013.

Paxymer business case: Mission & Vision

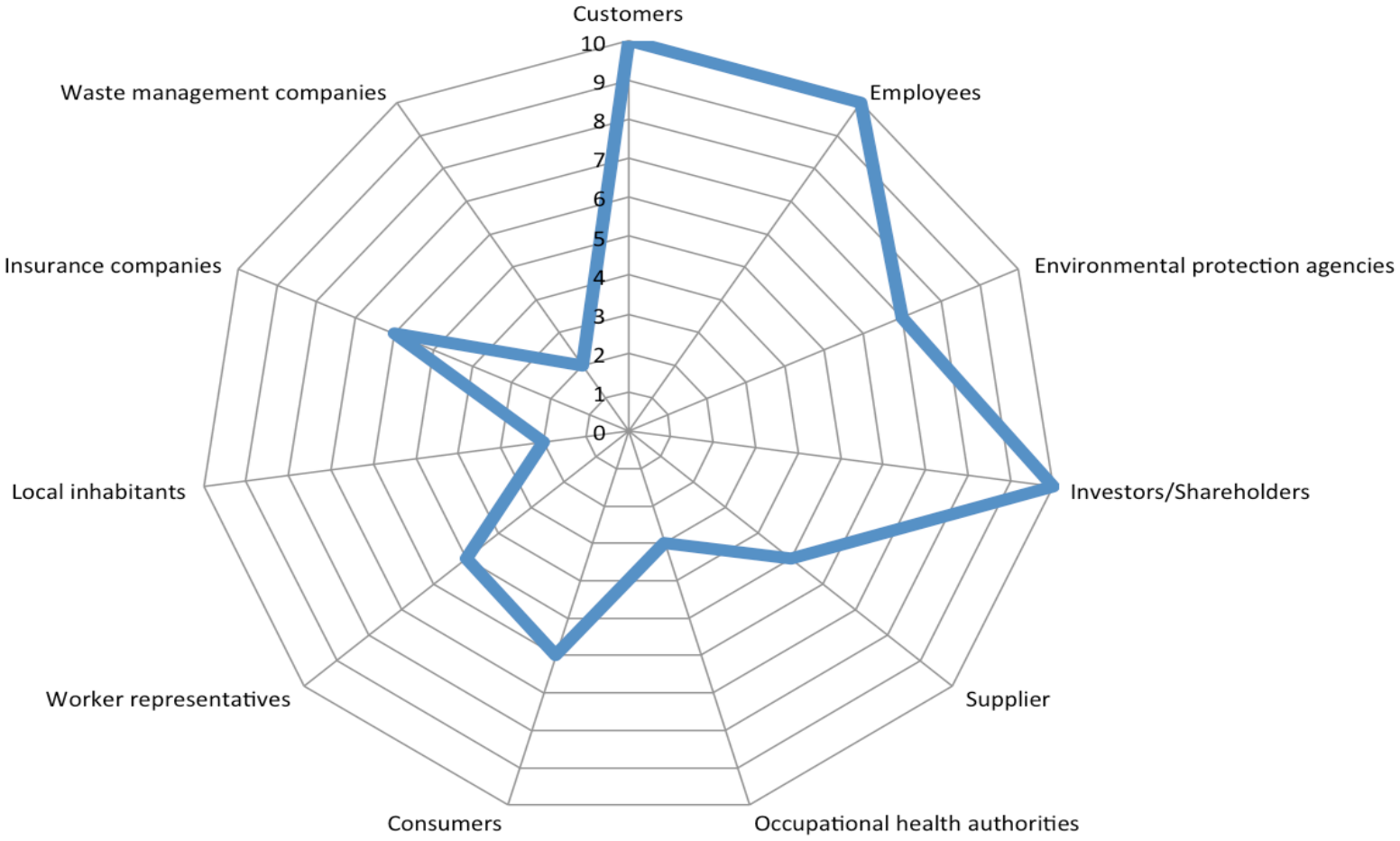
Mission

Paxymer® protects people and environment and is the number one green flame retardant system for polyolefin plastics.

Vision

Paxymer® is a leading center of excellence for all its stakeholders within our field of operations.

Paxymer business case: Stakeholders' analysis



Source: Module material figure 5. Chapter 2.3

Paxymer business case: Barriers & opportunities

- ✓ Timing/Market maturity
- ✓ Understanding the value proposition
- ✓ Market structure/Conservative market
- ✓ Education of customers
- ✓ Financing

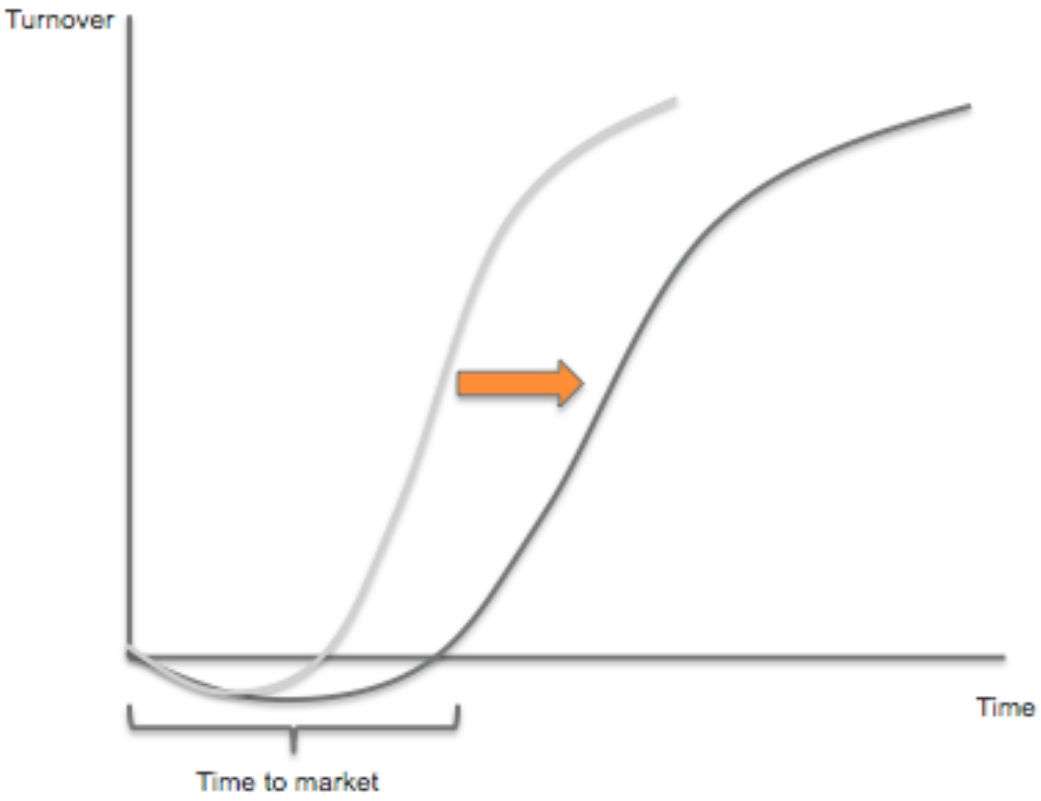
Paxymer business case: Barriers & opportunities

Timing/Market maturity

The product development curve is shifted so that time to market is extended.

This has implications for company strategy and financing

Timing an innovation so that it fits well with the market maturity will make a more rapid growth curve possible



Source: Module material figure 6. Chapter 2.3

Paxymer business case: Barriers & opportunities

Value proposition

Initial value proposition

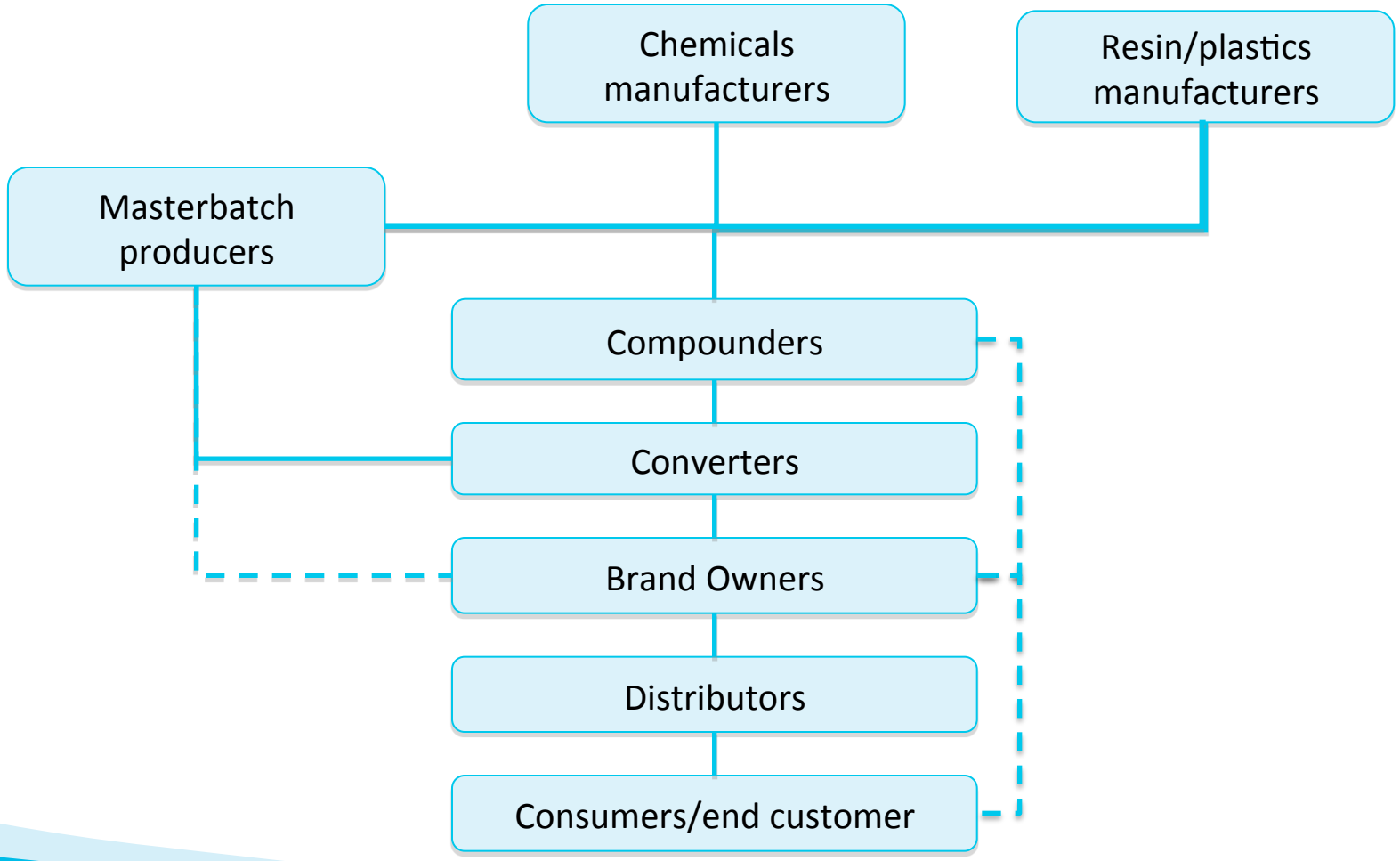
- Halogen-free
- Environmentally friendly
- Unique burning performance
- Unique proprietary technology

Developed value proposition

- Low impact on mechanical and processing behaviour
- Non-dripping burning behaviour
- Low smoke toxicity
- Free from persistent, carcinogenic and endocrine disrupting chemicals
- Halogen-free flame retardant

Paxymer business case: Barriers & opportunities

Market structure/Conservative market



Paxymer business case: Barriers & opportunities

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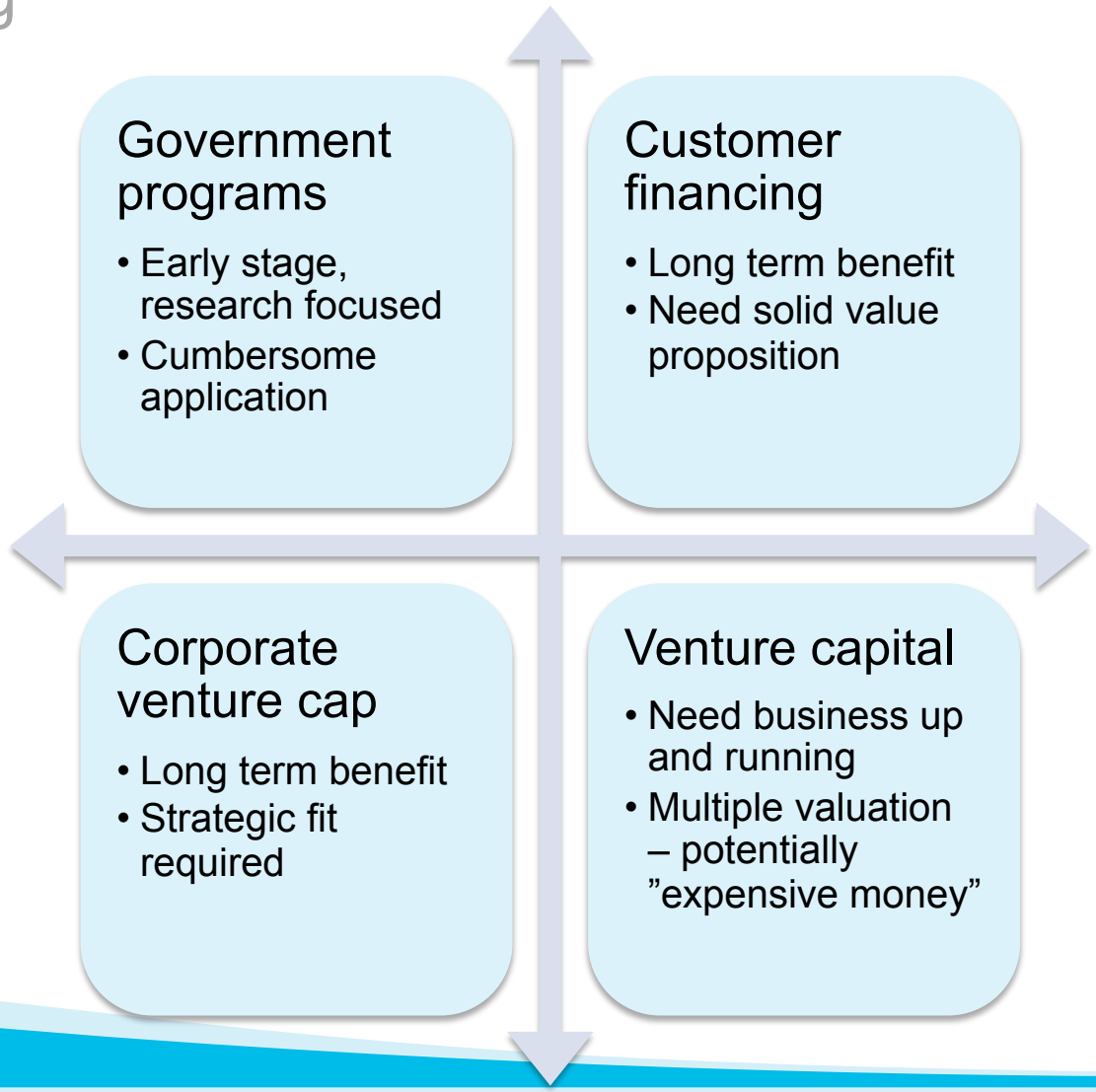
Paxymer business case: Barriers & opportunities

Financing



Module 2 Exercise: Stakeholder analysis

Goals:

- ✓ Making a stakeholdar analysis in the local context
- ✓ Get insight into how one can use the framework
- ✓ Understand the variety of stakeholders and their influence
- ✓ Identify local barriers and opportunities
- ✓ Understand participants' experience and interests in substitution

Tasks:

In small groups (30 min)

1. Focus on one of the ventures in the groups your are placed in

2. Consider influences on the venture of:

- Customers,
- Employees,
- Environmental protection agencies,
- Investors/Shareholders,
- Supplier,
- Occupational health authorities,
- Consumers,
- Worker representatives,
- Local inhabitants,
- Insurance companies,
- Waste management companies

3. Organise them in a list based on the potential business impact.

Module 3: Identification of chemicals of high concern

- ✓ Criteria and definitions for substances of high concern

Sara Perez Díaz,
ISTAS' chemical expert

Defining substances of high concern

- ✓ **Carcinogens**: may cause cancer or increase its incidence
- ✓ **Mutagens:** may induce heritable genetic damage
- ✓ **Reproductive toxicants**: impair the ability to get children
- ✓ **PBT (Persistent Bioaccumulation and Toxicity):** persistence, ability to accumulate in living organisms, and mainly their high toxicity
- ✓ **Endocrine disruptors**: Interfere with hormone system
- ✓ **Neurotoxicant:** adverse effects in the nervous system
- ✓ **Sensitization agent:** create a situation of airway hypersensitivity (allergies)

Module 3: Identification of chemicals of high concern

Goals:

- ✓ Introduce participants to the different criteria and definitions for substances of high concern as presented on SUBSPORT.
- ✓ Provide participants with tools to establish their own criteria to define substances of high concern.
- ✓ Promote the exchange of experience on substances of concern subject to substitution among participants

Tasks:

In small groups (20 min)

- ✓ Define your priority substances for substitution according to their intrinsic hazardous properties
- ✓ Check which of the ingredients are included in one or more “restriction” lists

Module 4: How and where to identify alternatives

- ✓ Use, function and need of chemicals
- ✓ Tools and sources of information to identify alternatives
- ✓ Substitution steps

Sara Perez Díaz,
ISTAS' chemical expert

Module 4: How and where to identify alternatives

Goal:

✓ Provide guidance on methods for identifying potentially feasible and safer alternatives to the chemicals of concern.

Tasks:

In small groups (15 min)

Read the text 4.1. DEFINE USE, FUNCTION AND NEED.
Discuss the use, function and need of the following chemicals and think about possible alternatives:

- **Phthalates** in toys for children
- **Trichloroethylene** for degreasing of metal parts
- **Brominated flame retardants** in TV enclosures

In small groups (20 min)

✓ Use both search functions on the SUBSPORT website to look for possible alternatives to the above mentioned chemicals and discuss what you found. In addition use also the “normal” Google search.

Large group (15 min)

✓ Each small group shares how they defined function, use and need and the possible alternatives they have identified.

Comments

BPA in polycarbonate of baby bottles

- ✓ **Function:** BPA is a structural constituent of polycarbonate
- ✓ **Use**: manufacture of beverage containers and bottles. Ultimate need is to feed babies.
- ✓ **Need:** Light, shock resistant bottles.
- ✓ Examples of possible alternatives:
  - ✓ Alternative substances: BPA free plastic bottles: PE, PP.
  - ✓ Alternative materials: glass bottles
  - ✓ Alternative process: breastfeeding

Comments

Trichloroethylene as ingredient of a metal parts degreaser

- ✓ **Function:** solvent
- ✓ **Use**: degreaser
- ✓ **Need**: Cleaning of metal pieces for further use or treatment
- ✓ Examples of possible alternatives:
  - ✓ Alternative substances: fatty acid esters based on vegetable oils
  - ✓ Alternative process: CO2 dry ice blasting, vapor degreasing
  - ✓ Organizational change: producing clean metal pieces

Comments

DecaBDE used as flame retardant in computer casings

- ✓ **Function:** flame retardant
- ✓ **Use**: computer casings
- ✓ **Need:** fire safety in appliances (computers)
- ✓ Examples of possible alternatives:
  - ✓ Alternative substances: resorcinos bil (diphenylphosphate)
  - ✓ Alternative casing material that avoid the need for flame retardants: aluminium

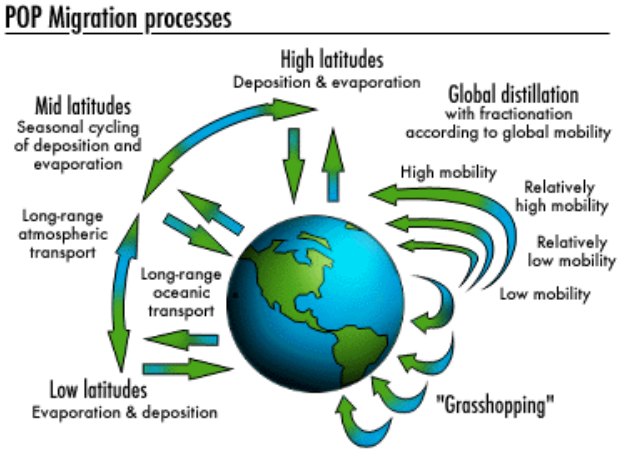
Module 5: POPs' substitution and safe work procedures

- ✓ POPs definition
- ✓ POPs effects on health and environment
- ✓ Safe work procedures
- ✓ POPs substitution experiences

POPs Definition

Persistent Organic Pollutants: carbon based chemical substances.

- ✓ High persistence in the environment and high resistance to degradation
- ✓ Capability to bioaccumulate in tissues of living organisms and to biomagnify in food chains
- ✓ High toxicity with serious human and environmental effects
- ✓ Potential to travel long distances and reach areas and remote regions where they have never been used



Greenpeace

Classification

Can be placed in 3 categories:

- ✓ **Pesticides:** aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, chlordecone, alpha hexachlorocyclohexane, beta1 hexachlorocyclohexane, lindane, pentachlorobenzene
- ✓ **Industrial chemicals:** hexachlorobenzene, polychlorinated biphenyls (PCBs), hexabromobiphenyl, hexabromodiphenyl ether and heptabromodiphenyl ether, pentachlorobenzene, perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride, tetrabromodiphenyl ether and pentabromodiphenyl ether
- ✓ **By-products:** hexachlorobenzene; polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF), PCBs, alpha hexachlorocyclohexane, beta hexachlorocyclohexane and pentachlorobenzene

POPs effects on health and environment

POPs imply a serious threat to human health and to the global environment:

- ✓ Several types of cancer and tumours
- ✓ Allergies or hypersensitivity
- ✓ Damage to central and peripheral nervous system
- ✓ Behavioural changes
- ✓ Disorders of inmune system
- ✓ Disorders of reproductive system

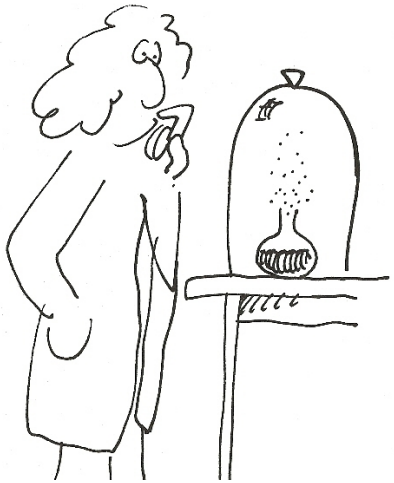
Women, newborn and children are particularly vulnerable

Many effects pass to the next generation

Risk reduction

- ✓ Elimination/substitution

- ✓ Emission control



Safe work procedures

- ✓ There is no safe level of exposure, emission or dumping of these chemicals given their persistence and capability to accumulate in living organisms
- ✓ Their elimination and substitution are a priority
- ✓ Only in cases where replacement is not technically feasible other measures must be taken to reduce occupational and environmental exposure
- ✓ Priorities in the implementation of preventive measures are defined by the principles of preventive action

Principles of prevention action

- ✓ Avoiding risk
- ✓ Evaluating the risks which cannot be avoided
- ✓ Combating risks at source
- ✓ Adapting the work to the individual
- ✓ Adapting to technical progress
- ✓ Developing a coherent overall prevention policy
- ✓ Give collective protective measures priority over individual protective measures

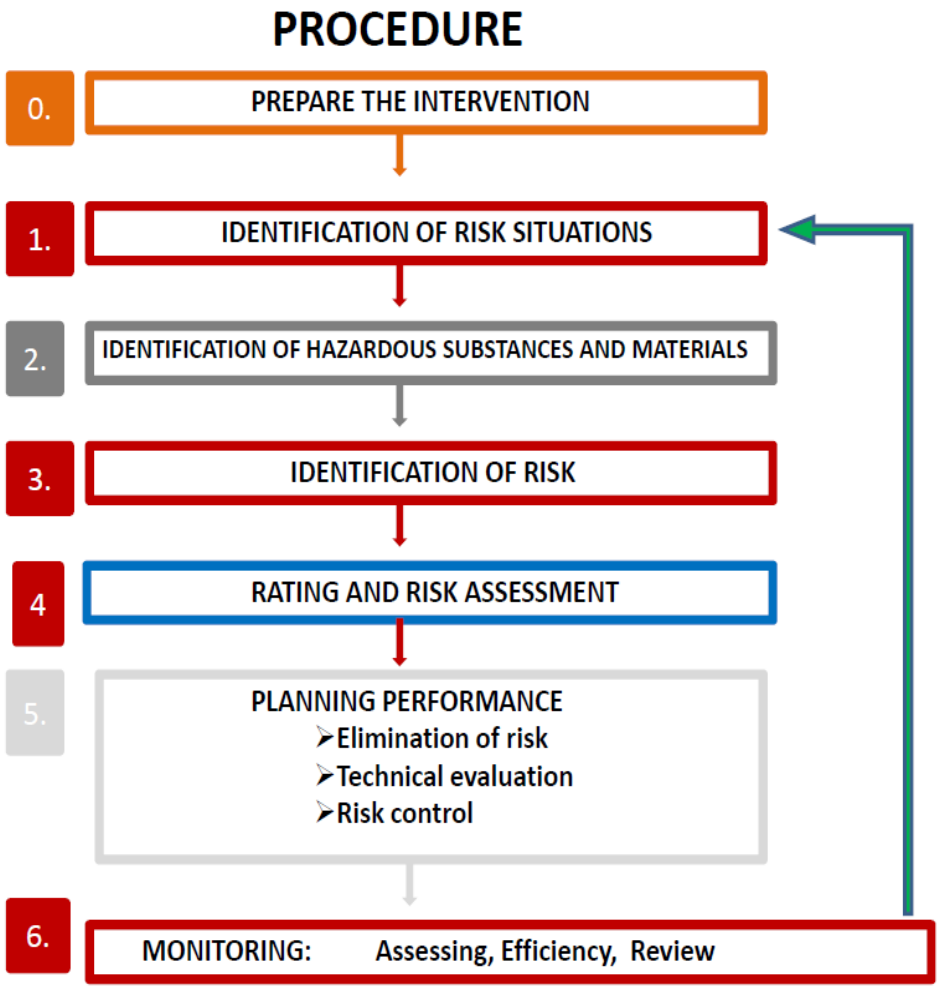
Procedures for action on chemical risks

- ✓ Preparing the intervention
  - Existence of chemical risks in the company
  - Human and environmental effects of chemical products;
  - Possibility of avoiding or reducing risk (less hazardous substances, best practices, etc...)
- ✓ Identification of risk situations
- ✓ Identification of hazardous substances and materials
- ✓ Identification of risk

Procedures for action on chemical risks

- ✓ Rating and risk assessment
  - Properties
  - Characteristics of exposure
  - Conditions of use
  - Health effects caused by exposure
  - Waste generation and uncontrolled emissions, discharges of chemical products
  - Workers' and experts' opinions
- ✓ Planning performance
  - Training and information for workers
  - Control and reduction of exposure
  - Health surveillance measures
- ✓ Monitoring

Procedures for action on chemical risks



POPs substitution experiences (I)

Alternative engineering plastic completely free from brominated flame retardants, PVC and plasticizers for electronics.

- ✓ The applications of the plastic are mainly in components for electronics, such as connectors and sockets, relays and semiconductor packages
- ✓ Until recently, the electronics industry generally considered brominated flame retardants and PVC plastic to have an ideal performance/safety balance
- ✓ The inappropriate incineration of end-of life electronics equipment via informal recycling has led to a growing concern that these materials pose risks to health and the environment.

POPs substitution experiences (I)

- ✓ The company DSM developed and produces new bromine- and chlorine- free flame retardant engineering plastics that meet high technical and environmental performance standards
- ✓ Working together with partners throughout its entire value chain, including Original Equipment Manufacturers as well as suppliers
- ✓ These solutions enforce the competitive advantage for the emerging market demand for BFR- and PVC-free products in the electronics sector
- ✓ DSM was among the first chemical companies to offer a complete portfolio of engineering plastics that are free of bromine and chlorine.

POPs substitution experiences (I)

Substituted substances

- ✓ DecaBDE: endocrine disrupter
- ✓ Tetrabromobisphenol A (TBBPA): Very toxic to aquatic life with long lasting effects and endocrine disrupter
- ✓ Hexabromocyclododecane (HBCDD): POPs

Alternative substance

- ✓ Polyamide 4t (stanyl fortii)

POPs substitution experiences (I)

Advantages

- ✓ By actively driving the development of chlorine- and bromine- free plastics components for the electronics sector, DSM was able to achieve breakthroughs that enabled the company to leap ahead of its competitors
- ✓ DSM fully intends to continue developing sustainable solutions that meet the emerging market demands for eco-friendly products.
- ✓ The company expects to continuously improve the quality of its halogen-free portfolio.
- ✓ DSM is also active in developing bio based engineering plastic polymers that avoid or reduce the use of petroleum
- ✓ Also improving the recyclability and eco-efficiency of its engineering plastics.

POPs substitution experiences (II)

Successful phase out of examination gloves containing phthalates, latex and PVC

- ✓ Examination gloves are used extensively in modern healthcare. Many gloves contain harmful chemicals such as phthalates, latex and PVC.
- ✓ These can be substituted with gloves made of nitrile rubber, neoprene or polyurethane as has been shown by the Swedish National Substitution Group and SEMCO
  - SEMCO (Miljöstyrningsrådet) is the Swedish government's expert body on environmental and other sustainable procurement.
  - The Swedish national substitution group is a voluntary initiative and a network of engaged personnel at Swedish hospitals and universities who inform each other about safer alternatives both regarding products and chemicals.

POPs substitution experiences (II)

Substituted substances

- ✓ Polyvinyl chloride (PVC): chlorinated compound. Hexachlorobenzene (POP) is used during production process.
- ✓ Natural latex
- ✓ Phthalates: endocrine disrupter, toxic for reproduction, sensitizer

There are also potential negative effects in production where mercury are sometimes used and after use since PVC can form dioxins when combusted.

Alternatives substances

- ✓ Polyurethane (PU)
- ✓ Nitrile rubber
- ✓ Neoprene

POPs substitution experiences (II)

The use of PVC or latex in gloves is problematic for several reasons

- ✓ The phthalates are easily transferred from the glove to the user.
- ✓ PVC is also known to have a negative impact on the environment both in production (where large amounts of mercury may be used) and in waste treatment (where dioxins may be released)
- ✓ Gloves made of latex can be problematic, because of latex allergy.

Alternative

- ✓ Gloves of nitrile, neoprene or polyurethane
- ✓ Nitrile gloves are strong and protects well from chemicals
  - Some nitrile gloves may contain rubber additives that can cause allergic reactions, but there are alternatives for these chemicals

POPs substitution experiences (II)

Example of success substitution:

Stockholms Läns Landsting (Stockholm County) has successfully phased out the majority of PVC gloves, starting 2004, and uses the following requirements for procurement of gloves:

- ✓ Free of phthalates
- ✓ Free of PVC
- ✓ Free of latex
- ✓ Free of powder
- ✓ Low levels of rubber additives

During 2004, 100 tons of phthalates were phased out from Stockholms läns landsting.

The procurement process also reduced the price on nitrile gloves from double the price of PVC gloves to almost the same level as the PVC gloves by 2009.

POPs substitution experiences (III)

Water-based technology to produce polyurethane and polyester/ polyamide microfibers

- ✓ Nonwoven-based polyurethane and polyester/polyamide microfibers (generally known assuede) are increasingly used in the following fields of application:
  - home application (furnishing and upholstery)
  - car interiors
  - contract
  - air-plane seating
- ✓ Technology, called Dinamica®, developed by Miko and patented by the Japanese partner Asahi Kasei
- ✓ Alternative technology to produce microfibers using water as the only solvent.
- ✓ Complete substitution and/or elimination of different organic solvents normally used in this process

POPs substitution experiences (III)

Substituted substances

- ✓ Solvents commonly used: tri-and tetrachloroethylene and dimethylformamide (DMF)
- ✓ Flame retardants such as antimony trioxide, pentabromophenyl, decabromodiphenyloxide and other halogenated compounds
- ✓ All of these chemicals are well known for having hazardous properties posing risk to workers and to the environment

POPs substitution experiences (III)

Technological alternative

- ✓ Dinamica® by Miko is an ecological microfiber made from recycled polyester.
- ✓ The use of recyclable is favourable also from a resource efficiency point of view
- ✓ Also gives the materials flame retardant properties without the addition of chemical flame retardants
- ✓ The product was the winner of the Italian Environmental Business Award 2011 for Best Product.
- ✓ For the production the company does not use harmful solvents and uses only neutral and non-toxic dyes.
- ✓ Its production cycle is based on a unique water process in order to guarantee fully respect for human health and the environment.

Module 5: The material substitution in practice

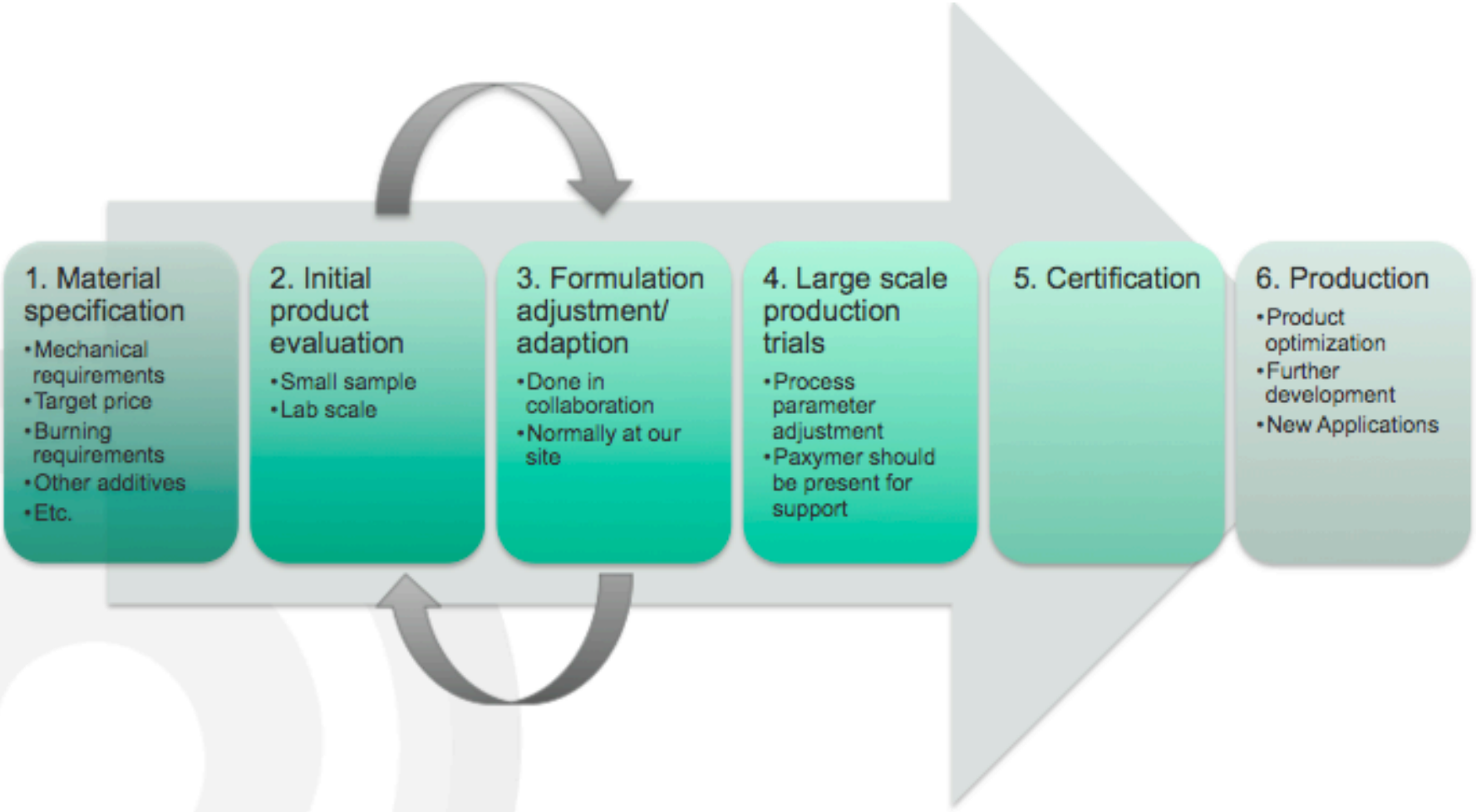
Business case:

Welding mask in PP

Amit Paul,

Paxymer AB

Business case: Typical sales process



Source: Module material figure 4. Chapter 1.5

Business case: Welding mask in PP

Situation	• New material development initiative with customer. • All investments were made apart from the flame retardant.
Challenges	• Meeting material specification • Meeting the fire specification • Finding a halogen-free solution
Actions	• Involvement in development • Joint effort between OEM, Paxymer and subcontractor • Adaption of formulation the specific customer demands
Results	• Worldwide product launch • New low-cost position for the customer on the market

Source: Module material figure 3. Chapter 1.5

Business case: Stakeholder analysis - OEM

- ✓ **Corporate policy:**
  The company has a policy not to use hazardous chemicals and were limited to stay away from brominated compounds

- ✓ **Resource availability:**
  Entry point was an established relationship with the development department of the company which put Paxymer® on the map as a technical alternative

- ✓ **Technical progress:**
  Fire, mechanical and processing properties were met

- ✓ **Supply chain requirements:**
  The company was the main driver in the process for substitution. The solution met processing requirements sufficiently.

Business case: Stakeholder analysis - OEM

- ✓ **Costs:**
  The company had selected a low cost profile and switched from Polyamide to a Polypropylene (one third of the cost) some of this advantage disappeared by including FR, savings were still significant.

- ✓ **Regulations:**
  No external regulation. It was driven by company policy.

- ✓ **Environmental, health and safety concerns:**
  Inclusion of the fire safety system was necessary for the product to meet the demands and the corporate policy of avoiding hazardous chemicals were driving factors in this case.

Module 6: Alternatives assessment

- ✓ Define acceptance criteria for alternatives
- ✓ Asses and compare alternatives
- ✓ The column model
- ✓ Green Screen for safer chemicals

Acceptance criteria for alternatives

- ✓ Determine which alternatives are not acceptable in any case

  - ✓ Carcinogens and mutagens
  - ✓ Reproductive toxicants
  - ✓ PBT (Persistent Bioaccumulation and Toxicity)
  - ✓ Endocrine disruptors
  - ✓ Neurotoxicant
  - ✓ Sensitization agent

Asses and compare alternatives

Different aspects may be consider:

- ✓ Effects on human health and the environment
- ✓ Effectiveness
- ✓ Technical viability
- ✓ Economic viability

- ✓ User must set their own standards (effectiveness vs human health effects…)
- ✓ Several methods have been developed to carry out such evaluations
- ✓ Limitation: lack of data on hazards for most chemicals in use

The column model

Elaborated by the IFA, Institute for Occupational Safety and Health of the German Social Accident Insurance

- ✓ Provide industry with a practical tool for assessment of alternative substances
- ✓ Based on 6 columns in which the following hazard categories are described:
  - Acute health hazards
  - Chronic health hazards
  - Fire and explosion hazards
  - Environmental hazards
  - Exposure Potential
  - Process hazards
- ✓ Columns are divided into cells/boxes that contain the criteria to estimate the level of risk based on risk phrases (R phrases)

The column model

- ✓ Users can compare risk levels of the substance in use and the alternatives
- ✓ Easy to handle by-non professional users, does not require special expertise if Chemical Data Sheet are available
- ✓ Products are compared by type of hazard
- ✓ Which potential hazards are more relevant for the workplace?

Green Screen for Safer Chemicals

Developed by Clean Production Action (CPA)

- ✓ Designed to inform decision-makers in businesses, governments and individuals concerned with the risks posed by chemicals
- ✓ The Green Screen defines four benchmarks on the path to safer chemicals
  - Benchmark 1: Avoid. Chemicals of high concern.
  - Benchmark 2: Use but search for safer substitutes.
  - Benchmark 3: Use but still opportunity for improvement.
  - Benchmark 4: Safe chemical
- ✓ Each benchmark includes a set of hazard criteria
- ✓ Limitation: Only used to assess and compare individual chemicals

  Requires specific training. Not suitable for SMEs or consumers

This chemical passes all of the criteria.

BENCHMARK 4

ready biodegradability (low P) + low B + low Human Toxicity + low Ecotoxicity
(+ additional ecotoxicity endprints when available)

Prefer—Safer Chemical

BENCHMARK 3

a. moderate P or moderate B
b. moderate Ecotoxicity
c. moderate Human Toxicity
d. moderate Flammability or moderate Explosivenesness

Use but Still Opportunity for Improvement

If this chemical and its break-down products pass all of these criteria, then move on to Benchmark 4

BENCHMARK 2

a. moderate P + moderate B + moderate T
(moderate Human Toxicity or moderate Ecotoxicity)
b. high P + high B
c. (high P + moderate T) or (high B + moderate T)
d. moderate Human Toxicity for any priority effect or high Human Toxicity
e. high Flammability or high Explosiveness

Use but Search for Safer Substitutes

If this chemical and its break-down products pass all of these criteria, then move on to Benchmark 3

BENCHMARK 1

a. PBT: high P + high B + high T[1] (high Human Toxicity[2] or high Ecotoxicity)
b. vPvB: very high P + very high B
c. vPT (vP + high T) or vBT (vB + high T)
d. high Human Toxicity for any priority effect[3]

Avoid—Chemical of High Concern

If this chemical and its break-down products pass all of these criteria, then move on to Benchmark 2

FOOTNOTES:
1 Toxicity – "T" = human toxicity and ecotoxicity
2 Human Toxicity = priority effects (see below) or acute toxicity, immune system or organ effects, sensitization, skin corrosion, or eye damage
3 Priority Effects = carcinogenicity, mutagenicity, reproductive or developmental toxicity, endocrine disruption, or neurotoxicity

ABBREVIATIONS:
B = bioaccumulation **P**=persistence
T=human toxicity and ecotoxicity
vB=very bioaccumulative **vP**=very persistent

Module 6: Assessment of alternatives

Goals:

- ✓ Providing guidance on methods for the assessment of alternatives.

Tasks:

In small groups (60 min)

- ✓ Read texts:

  6.1. DEFINE CRITERIA
  6.2. ASSESS AND COMPARE ALTERNATIVES

- ✓ Assess and compare the alternatives of the EXAMPLE in text 6.3. using the Column Model.

Large group (20 min)

- ✓ Each small group shares the results of their assessment.

Alternatives assessment. Example

	Acute Tox.	Chronic Tox.	Environ.	Fire & Explosion	Exposure potential	Proced.
ACRI BOND	High Risk: R43	High Risk: R40		High Risk: R11	Very high risk>250hPa	
VERTREL	Low risk: R65,67,38		Very High Risk: R 50-53	High Risk: R11	Very high risk>250hPa	
ESTASOL	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Low risk	

Module 7: Alternatives/cost assessment

- ✓ Cost assessment in the customer scenario (exercise)

Amit Paul, Paxymer

Resistance for substitution

Three difficulties discovered for achieving substitution

- ✓ Implementation difficulties – cost/investment/functionality
- ✓ Incremental innovation
- ✓ Lacking documentation/supply of green alternatives

Source: Dr Martin Scheringer, IPCP

Cost assessment – example part 1

Current alt. w Halogens	Yes				
Quantity (MT)	10				
Fire requirement	EN-61386				
	With Paxymer			Current FR	
Marterial	Cost (€/kg)	Dosing (%) 100,0%		Cost (€/kg)	Dosing (%) 100,0%
Base plastic	1,75	82,0%		1,75	88,0%
Flame retardant	8,50	18,0%		13,00	2,0%
Flame retadrant syn.				10,50	10,0%
Additives					
Impact					
Color					
Coupling					
Process add					
UV-stab					
Other					
Material cost	2,97 €/kg			2,85 €/kg	

Conventional cost calculation kg/kg comparison

Paxymer is more expensive?!!

Cost assessment – example part 2

Other cost					
Labour cost*	26,07	€/h		26,07	€/h
Production speed	150	kg/h		150	kg/h
Scrap	1,50%			2,00%	
Waste handling	0	€/kg		0,25	€/kg
Maintenance***	65,78	€/h		66,11	€/h
Machine hourly rate**	5,04	€/h		5,04	€/h
Other cost	0,26	€/kg		0,52	€/kg
Total COGS	3,22	€/kg		3,37	€/kg

* Labour cost European average for manufacturing worker. Total cost or employer incl social benefits and fees etc. [2010]
** Electricity and depreciation. Energy is calculated 0,051€/kWh. Machine depreciation over 10 years.
*** assumed 1,5 h of downtime per shift for normal use. 1,25 h for Paxymer.

Putting up the full calculation Paxymer shows less cost due to more efficient processing – these aspects are rarely concidered in purchasing negotiations

Cost assessment – example part 3

Externalities					
Waste*	-	€/kg		0,35	€/kg
Worker safety**	-	€/kg		0,07	€/kg
Mechanical performance		€/kg			€/kg
Total for product	3,22	€/kg		3,79	€/kg

* Waste Incineration Brief figure for hazardous waste treatment. [2006]

** 40,1% of workers who are exposed to hazardous environment are affected in a typical year [Eurostat 63/2009]. A number of measures need to be carried out - watch over storage, limiting exposure, controls, measurements etc.

Including externalities into the calculation will further increase the difference between alternatives.

The increaseing use of LCA analysis, cradle to cradle concepts and zero discharge targets make companies increasingly aware of these costs

Source: Annex V in the training material

Concluding discussion: Substitution in the Algerian context

Goals:

- ✓ Repeating the learnings from the module
- ✓ What are the situation in the local context
- ✓ Increasing the awareness of the different stakeholders and how they contribute to facilitate substitution
- ✓ Todo-list for your everyday setting

Tasks:

In small groups (45 min)

1. Discuss what barriers you see to implement substitution in the Algerian context?
2. What can be done by different actors to overcome the barriers? Consider all different perspectives
   - Industry
   - NGO
   - Government
   - Scientists

Sharing of conclusions in the big group (30 min)

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UNEP MAP Regional Activity Centre for Sustainable Consumption and Production

Stockholm Convention on persistent organic pollutants (POPs)