Waste Minimization Techniques

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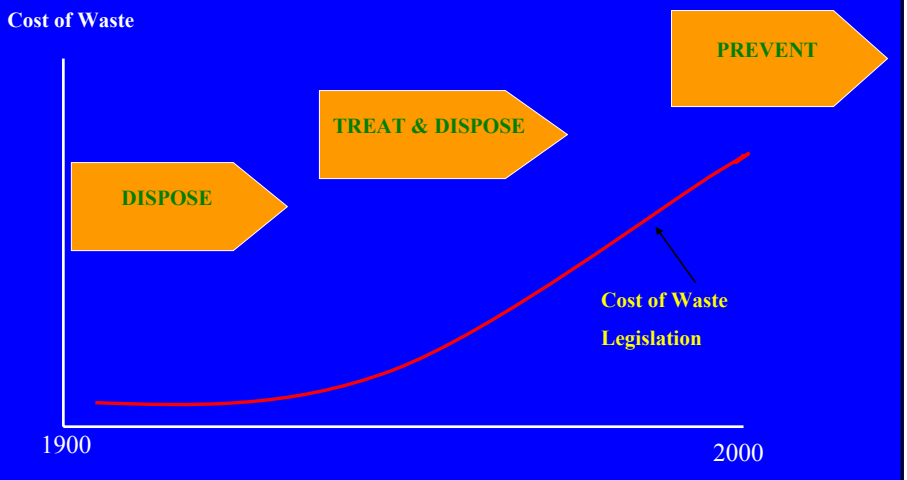
Waste Treatment



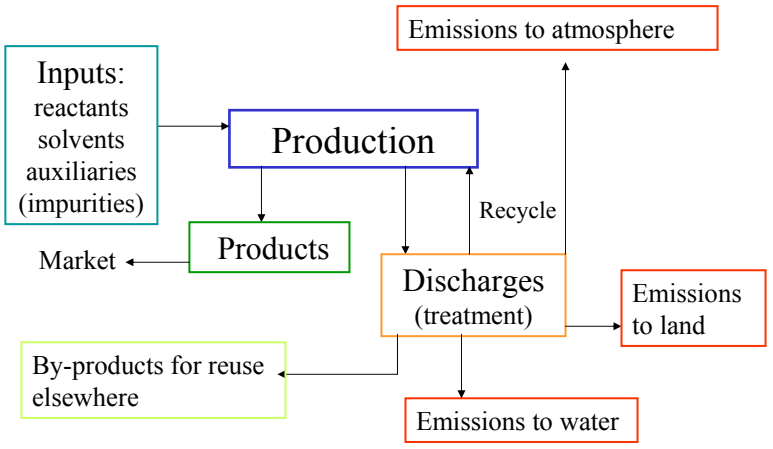
Waste Minimization Techniques

- Prevention is better than cure
- Get it right at the R&D stage
- Chemists do not have all the answers!
- The answer lies within a multi-disciplinary team
  - chemists
  - chemical engineers
  - production
  - business
  - health, safety, environment specialists
  - control engineers, environmental scientists, consultants/ etc

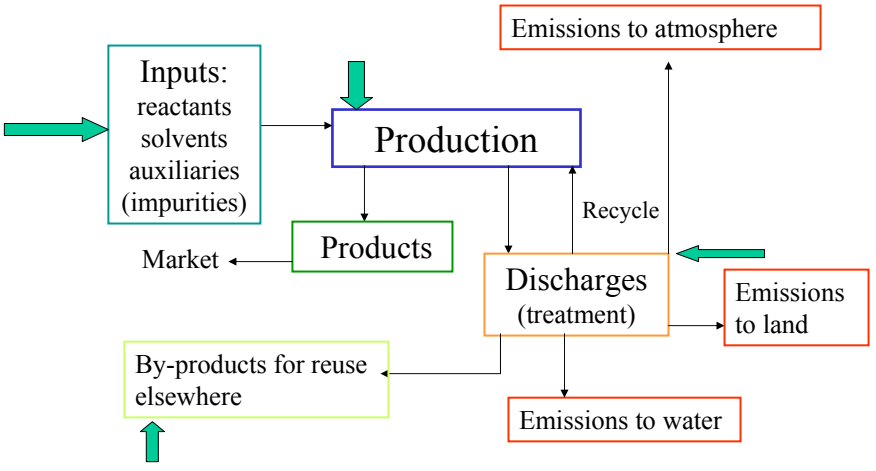
Table 2 Role of Teams in developing a new process selection

Chemist	Chem Eng.	Production	SHE	Business
Yield	Flow sheet	Operability	Emissions	Production cost
Purity	Heat & mass transfer	Convenience for shifts	Waste treatment	Waste disposal cost
Selectivity	Process costs	Operator safety	Regulatory compliance	Product packaging
By-product identification	Equipment choice	Materials handling	Operator safety	Product liability
Mechamism	Product isolation			Product quality

Waste & Production



Waste Reduction Possibilities



Waste Reduction Possibilities

- Inputs
  - eco friendly solvents, high purity reagents, recyclable auxiliaries, lass hazardous materials
- Production
  - change time, T& P, reactor types, mixing, heat transfer
  - new route, appropriate cleaning
- Discharges
  - reduce water volume, improved scrubbers, waste water clean up, mineralization of organics
- By-products
  - Maximise use, R&D, marketing, site integration

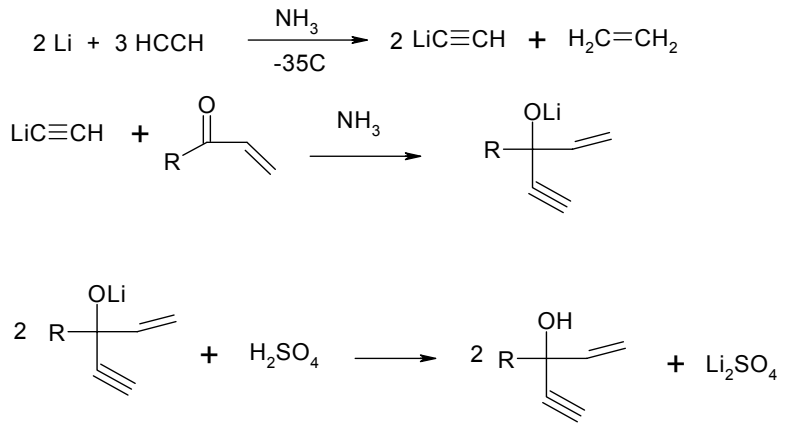
3M & 3Ps

- 3M 1975 - Pollution Prevention Pays
- Reduce need for end of pipe clean up
  - product development
  - engineering design
  - process optimisation
- Eliminated 1.5 billion gals waste water pa
- Reduced emissions to air by 100,000 tpa
- Examples: water based processes, energy recovery from solvent waste, replacing hazardous cleaning agents

Some Questions

- Do we need to use organic solvents at all?
- Is there a viable alternative to using protecting groups?
- Can a catalyst be used in place of a reagent?
- Is the proposed reactor the most efficient, from an energy efficiency and waste minimisation point of view?
- Can we use a less hazardous raw material?
- Is there a viable alternative to using an elimination reaction?
- What is the reason for lack of selectivity for a given reaction? Can it be overcome?
- Are processing aids, such as filter aids necessary?
- Can any waste or by-products be recovered for use in another process or product?

Etinol - Hoffmann La Roche



Input 3 kg raw materials
Output 1 kg product

Etinol Key Issues

- Expensive due to loss of 67% of raw material
  - Ethene production
  - significant resin formation in stage 2
  - Li lost with resin
- Improvements
  - R&D - vinyl ketone unstable in ammonia - add in organic solvent yields up by 15%, Li excess reduced, resins eliminated
  - Li could be recovered (not lost with resin), water used in stage 3 to recover LiOH - (off site conversion to Li)
  - engineering improvements to recycle acetylene & ammonia
  - use ethene as a fuel
  - acetylene use reduced by 50%, ammonia by 25%

Key Learning Points

- Problems of waste include inefficient use of resources 7 capital as well as risks to welfare and the environment
- Most developed countries have waste minimization programmes - recycling, energy efficiency
- At the process level, process flow sheets are invaluable in highlighting sources of waste.
- Most chemical products end up in the environment - they should be designed for recycle or degradation.

Waste minimization reading list

- R Carlson, *Silent Spring*, Houghton Mifflin, 1962, New York
- J Aguado & D Serrano, *Feedstock Recycling of Plastic Wastes*, 1999, Royal Society of Chemistry, Cambridge.
- C Christ, *Production-Integrated Environmental protection and Waste Management in the Chemical Industry,* Wiley-VCH, 1999, Weinheim
- W Hoyle & M Lancaster, *Clean Technology for the Manufacture of Speciality Chemicals,* RSC 2001, Cambridge
- Cuyahoga River Fire and Background - www.epa.gov/glnpo/aoc/cuyahoga.html
- History of detergent development & environmental issues www.chemistry.co.nz/detergenthistory.htm