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## Water Reuse and Environmental Conservation Project

### P2 Opportunities in Medical Devices and Therapeutic Sector

Dr. Bassam Hayek

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*Implemented by AECOM*



# Objective

To be able to describe key pollution prevention opportunities in medical and pharmaceutical enterprises

# Outline

- Key steps in P2
- Schematic process
- Examples of P2 opportunities
- Summary

# Key Steps to Identify and Implement P2

## 1. Planning

- Data needed, how to collect, assessment strategy

## 2. Preparation

- Team, resources, focus of assessment etc.

## 3. Assessment

- Material and energy flow analysis

## 4. Synthesis

- Identify and evaluate options

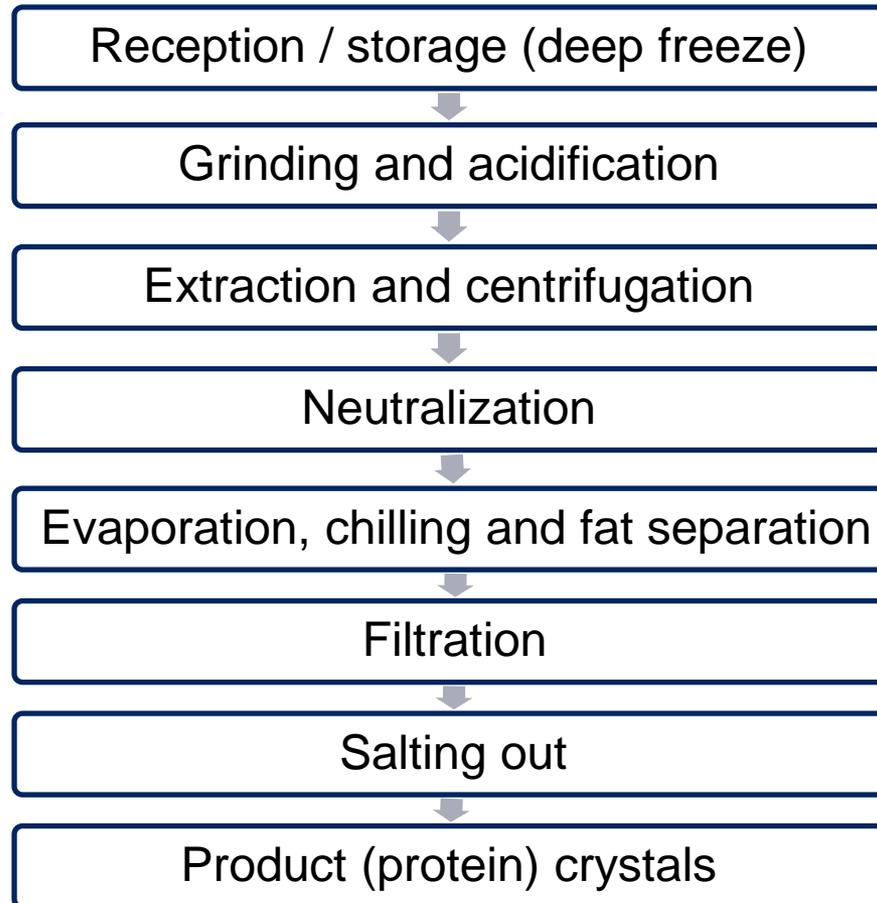
## 5. Implementation

- Select options, plan and implement

## 6. Sustaining

- Follow up on results and continue in another focus area

# Overall Flow Diagram (Insulin Production)



# NOTE

“Source reduction is one method by which the industry aims to reduce these wastes. However, source reduction methods such as process modifications and material substitutions may not be as easily implemented in the pharmaceutical industry as in other manufacturing sectors.”

*EPA Office of Compliance Sector Notebook Project:  
Profile of the Pharmaceutical Manufacturing Industry*

# Reception and Storage Opportunities

## Reception / Storage

- Control conditions: timing, **temperature**, location of freezer
- Manage inventory: don't store materials that will be needed after long times

# Grinding and Acidification Opportunities

## Grinding & acidification

- Waste: minimize / reuse improper material
- Power use
- Retention time / load per step
- Agitation speed
- Washing step (wastewater)

# Solvent Extraction Opportunities

## Solvent extraction

- Retention time
- Type and quality of alcohol (reuse)
- Separate waste: collect solid residues before washing
- Washing step
- Wastewater and solid residues

# Neutralization Opportunities

## Neutralization

- Concentration of basic solution
- Agitation speed (power)
- Washing step of vessel
- Wastewater, solid residues
- Separate wastes, collect solid residues before washing

# Evaporation, Chilling, Fat Separation Opportunities

## Evaporation, chilling & fat separation

- Temperature, pressure, duration, heat source
- Steam used (pressure / temperature)
- Insulation
- Separate waste: collect solid residues before washing
- Washing step of vessel
- Wastewater, solid residues (fat)

# Filtration Opportunities

## Filtration

- Pressure
- Separate waste: collect solid residues before washing
- Washing step
- Wastewater, solid residues

# Salting and Filter Opportunities

## Salting out / filter

- Quality of salt
- Spillage?
- Cleaning / washing
- Agitation speed
- Solid and liquid waste

## Example 1 of Benefits

**Eli Lilly Cleaning Technology Center** in late 1996 initiated a formal screening program to identify potential aqueous based cleaners as replacements for the **various organic and chlorinated solvents** currently used in bulk pharmaceutical manufacturing equipment cleanings.

## Example 1 of Benefits (2)

- In one product line, 8,700 liters of **acetone per cleaning** was replaced with an **alkaline aqueous** based cleaner for an estimated annual reduction of **17,400 liters** of acetone
- An **acid aqueous** based cleaner replaced **methanol** in another product line, resulting in methanol reductions of **25,800 liters** per year
- In cleaning operations associated with another product, an **alkaline aqueous** based cleaner replaced **117,000 liters** of **methanol** and **600 liters** of **ethylene dichloride** per cleaning

***This resulted in an estimated annual reduction of 368,000 liters of methanol and 1,200 liters of ethylene dichloride.***

## Example 2 of Benefits

### From a local research study:

- Solvent recovery in a local pharmaceutical company showed potential to save:
  - 160,000 kg/year of acetone
  - Cost of material is around 185,000 JD/year
  - Cost of disposal of waste acetone was around 95,000 JD/year

# Summary

- P2 opportunities can be simple management actions / housekeeping measures
- Source reduction can provide good examples of simple no cost P2 options
- Quality of raw material is an important aspect
- Avoid spills and contain them separately
- Control of conditions (temperature, pressure, agitation speed) could be common aspects
- Reuse of solvents (distillation and reuse)
- Water use (amounts / safety), reuse potentials

# References

- *Shreve's Chemical Process Industries* by George Austin
- Case study by Eng Haitham Salti, German – Jordanian University, presented at the 5<sup>th</sup> Arab CP workshop
- EPA Office of Compliance Sector Notebook Project: Profile of the Pharmaceutical Manufacturing Industry, Sector Notebook Project, 1997