Implementation of industrial ecology
for
Industrial hazardous waste management

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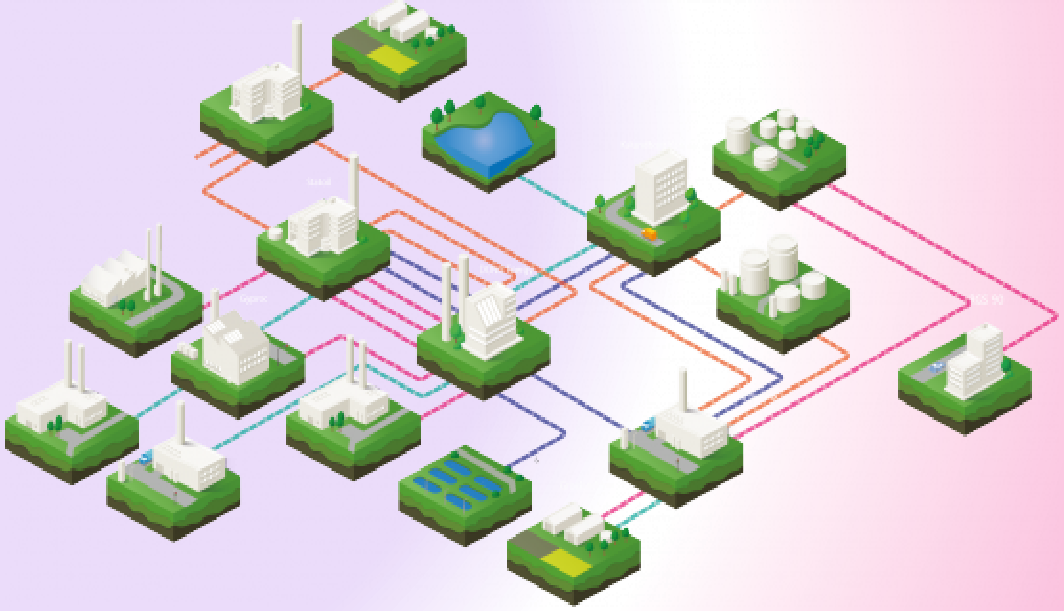

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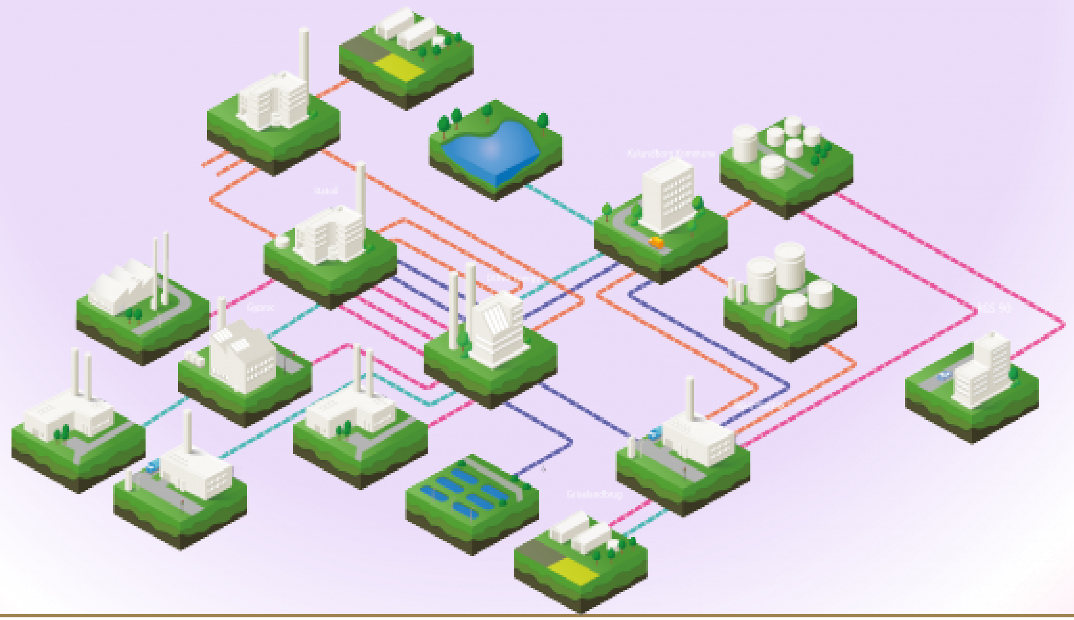

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About the presenter

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- **Member of the Board scientists Egypt.**
- **Member of Scientific Professions Syndicate.**
- **Member of the Arab Society for experts and Safety Professionals.**
- **Member of the International Association of Engineers.**
- **Expert in water and waste water treatment technologies.**
- **Certified trainer in water treatment field .**
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Topics include:

1. IE definitions, goals, roles, objectives, approach , applications.
2. Implementation framework, implementation levels.
3. Industrial ecologists' qualifications, ways and means for analysis and design

The benefits of IE

1. Relate to sustainable agriculture, industry, and environment, zero emission and

- zero discharge, hazardous wastes, cleaner production, waste minimization, pollution
- prevention, design for environment, material substitution, dematerialization,
- decarbonation, environmental restoration.

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Definitions of industrial ecology

❖ Ecology :

is the branch of biology that deals with the mutual relations between organisms and their environment.

❖ Industrial Ecology (IE) :

a framework for designing and operating industrial systems as sustainable and interdependent with natural systems.

Goal, role, and objectives

- A practical goal of industrial ecology is to lighten the environmental impact per person and per dollar of economic activity, and the role of the industrial ecologist is to find leverage, or opportunities for considerable improvement using practical effort.

- An overarching goal of IE is the establishment of an industrial system that recycles virtually all of the materials. It uses and releases a minimal amount of waste to the environment.

Tasks, steps, and framework for implementation

- 1. *Task 1*
- ***Eco-management***: *Brainstorm, test, and implement way s to reduce or* eliminate pollution;
- 2. *Task 2*
- ***Eco-auditing***: *Identify specific examples of materials use, energy use, and* pollution and waste reduction.
- 3. *Task 3*

Eco-accounting: *Count the money. Count how much was saved, then count* how much is still being spent creating waste and pollution, and start the cycle over.

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Cycle of continuous improvement (14 Steps)

- Step 1: Provide overall corporate commitment.
- Step 2: Organize the management efforts.
- Step 3: Organize the audit.
- Step 4: Gather background information.
- Step 5: Conduct detailed assessment.
- Step 6: Review and organize data.
- Step 7: Identify improvement options.
- Step 8: Prioritize options.
- Step 9: Implement fast-track options.
- Step 10: Analyze options.
- Step 11: Implement best options.
- Step 12: Measure results.
- Step 13: Standardize improvement.
- Step 14: Continue the process.

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Table 1 Implementation Process for Applying Industrial Ecology at Corporate Level

Task 1: Eco-management		Task 2: Eco-auditing		Task 3: Eco-accounting	
Step 1	Overall corporate commitment	*Step 3*	Organize the audit	*Step 5*	Conduct detailed assessment
Step2	Organize management efforts	*Step4*	Gather background information	*Step 12*	Measure results
Step 7	Identify improvement options	*Step 5*	Conduct detailed assessment		
Step8	Prioritize options	*Step6*	Review and organize data		
Step9	Implement fast-track options	*Step 7*	Identify improvement options		
Step 10	Analyze options	*Step 12*	Measure results		
Step 11	Implement best options				
Step 13	Standardize improvements				
Step 14	Continue the process				

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As shown in Table 1, the company must initially provide the overall corporate commitment (Step 1) and organize the management efforts (Step 2) in Task 1 that will drive this implementation process forward (and around). Once the industrial ecological implementation process is initiated by the eco-management team in Task 1 (Steps 1 and 2), the eco-auditing team begins its Task 2 (Steps 3–7) with background and theory that support an industrial ecology approach, and the eco-accounting team begins its Task 3 (Step 5) to conduct detailed assessment. The eco-management team must then provide step-by-step guidance and directions in Task 1 (Steps 7–11) to identify, prioritize, implement, analyze, and again implement the best options. Subsequently, both the eco-auditing team (Task 2, Step 12) and the eco-accounting team (Task 3, Step 12) should measure the results of the implemented best options (Task 1, Step 11). The overall responsibility finally to standardize the improvements, and to continue the process until optimum results are achieved (Task 1, Steps 13, 14) will still be carried out by the eco-management team.

Qualifications of industrial ecologists

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- 1. Industrial or manufacturing engineering of the target industrial system;
- 2. Energy consumption and material balances for environmental auditing;
- 3. Cleaner production, materials substitution, and dematerialization;
- 4. Zero emission, decarbonization, waste minimization, and pollution prevention;
- 5. Sustainable agriculture and sustainable industry;
- 6. Industrial metabolism and life-cycle analyses of products;
- 7. Site remediation and environmental restoration;
- 8. Ecological and global environmental analyses;
- 9. Accounting and economical analyses;
- 10. Legal, political affairs, and IE leverage analyses.

Design for environment (DFE)

- Is a systematic approach to decision support for industrial ecologists, developed within the industrial ecology framework.
- Design for environment teams apply this systematic approach to all potential environmental implications of a product or process being designed: energy and materials used ; manufacture and packaging; transportation; consumer use, reuse or recycling; and disposal.
- It also enables designers to consider traditional design issues of cost, quality manufacturing process, and efficiency as part of the same decision system.

Zero Emission

- The term "zero emission" is mainly used in the field of air emission control.
- Recent attention has focused on electric cars as zero-emission vehicles and the
- larger question of the energy and material system in which the vehicles are embedded.

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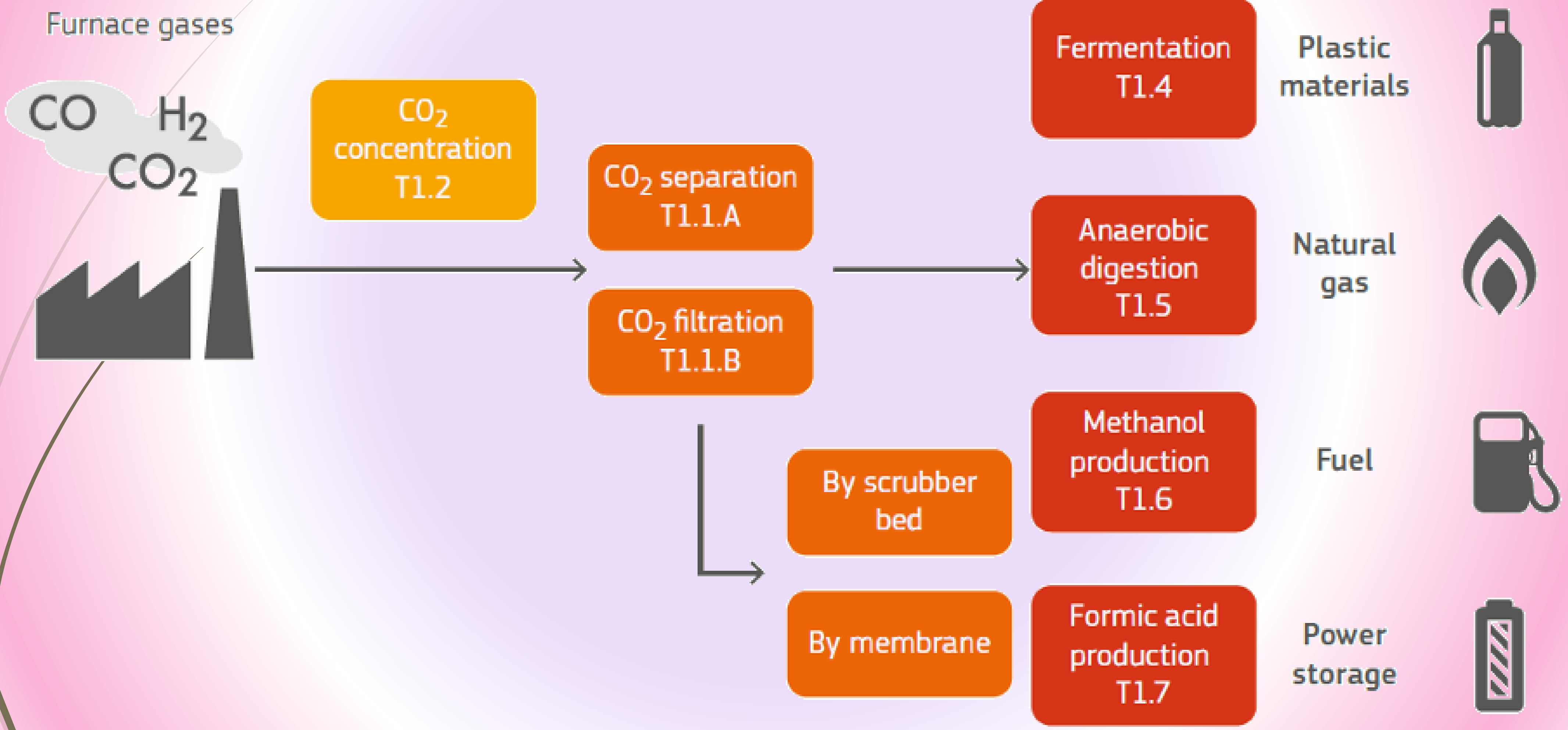

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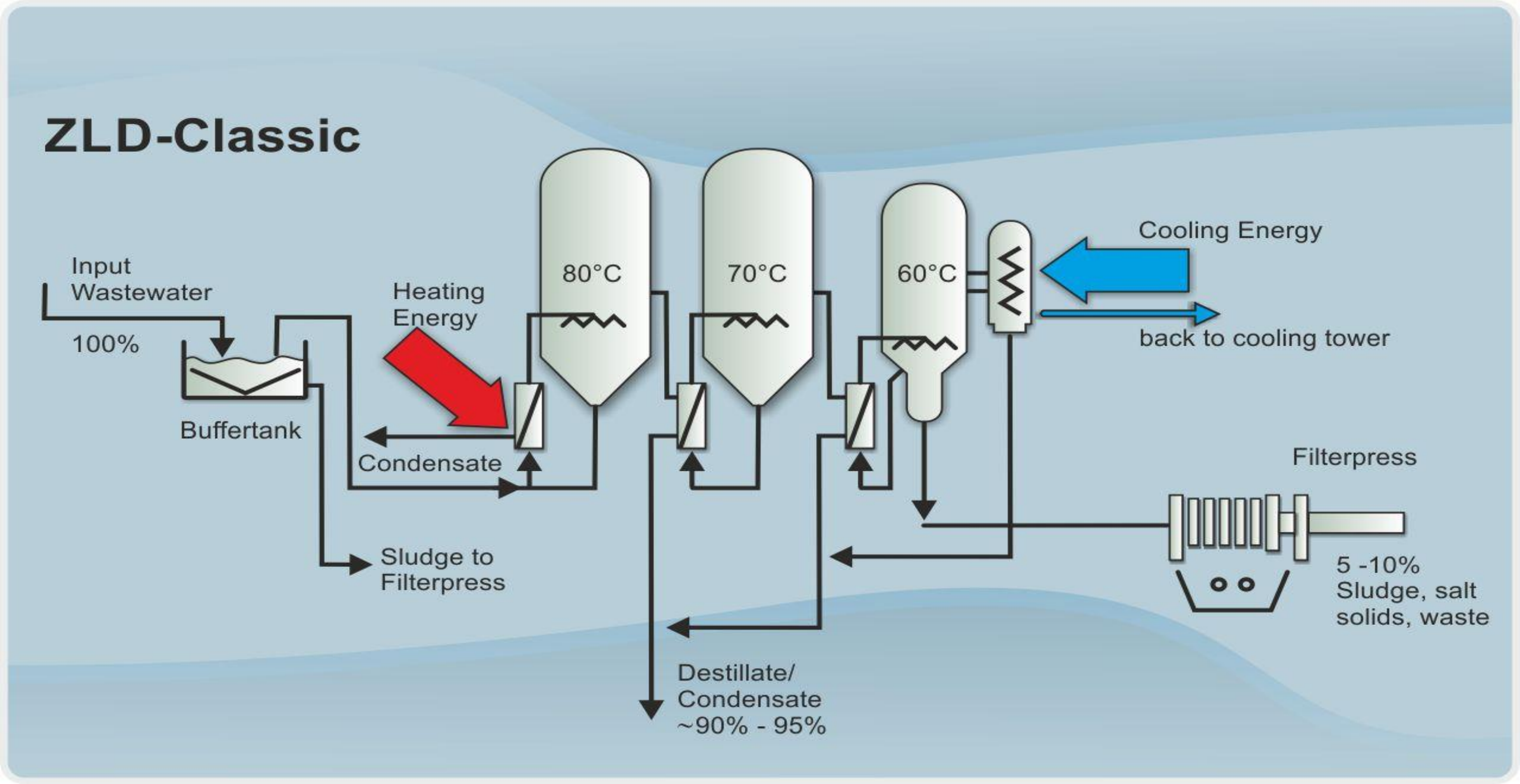
Zero Discharge

- The term "zero discharge" is mainly used in water and wastewater treatment plants, meaning total water recycle
- Zero discharge is aimed at total recycling of water and wastewater within an industrial system, and elimination of any discharge of toxic substances.


ZLD-Classic
Input
Wastewater
100%
Buffertank
Heating
Energy
Condensate
80°C
70°C
60°C
Cooling Energy
back to cooling tower
Filterpress
Sludge to
Filterpress
5 -10%
Sludge, salt
solids, waste
Destillate/
Condensate
~90% - 95%

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Total Wastewater Recycle in Potable Water Treatment Plants

- The volume of wastewater produced from a potable water treatment plant (either a
- conventional sedimentation filtration plant or an innovative flotation filtration plant)
- amounts to about 15% of a plant's total flow. Total wastewater recycle for production of
- potable water may save water and cost, and solve wastewater discharge problems

- Singapore is one of Asia's most powerful economies, but it lacks a reliable water supply. Wastewater-reuse plants could change that by soon recycling enough sewage to meet 50 percent of the nation's water needs.

- There are now four purification plants across Singapore producing 430 million liters of NEWater a day. The majority of what's produced is consumed by industry or by big cooling facilities.

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Examples

Total Water and Fiber Recycle in Paper Mills

- The use of flotation clarifiers and fiber recovery facilities in paper mills may achieve near total water and fiber recycle and, in turn, accomplish the task of zero discharge.

Total Water and Protein Recycle in Starch Manufacturing Plants

- The use of membrane filtration and protein recovery facilities in starch manufacturing plants may achieve near total water and protein recycle and, in turn, accomplish the task of zero discharge

Case Study

New Galvanizing Steel Technology Used at Delot Process SA Steel Factory, Paris, France

- Galvanizing is an antirust treatment for steel. The traditional technique consisted of chemically pretreating the steel surface, then immersing it in long baths of molten zinc at 450°C. The old process involved large quantities of expensive materials, and highly polluting hazardous wastes.

- The cleaner production technologies include: (a) induction heating to melt the zinc, (b) electromagnetic field to control the molten zinc distribution, and (c) modern computer control of the process.

- The advantages include total suppression of conventional plating waste, smaller inventory of zinc, better process control of the quality and thickness of the zinc coating, reduced labor requirements, reduced maintenance, and safer working conditions. With the cleaner production technologies inplace, capital cost is reduced by two-thirds compared to the traditional dip-coating process. The payback period was three years when replacing existing plant facilities.

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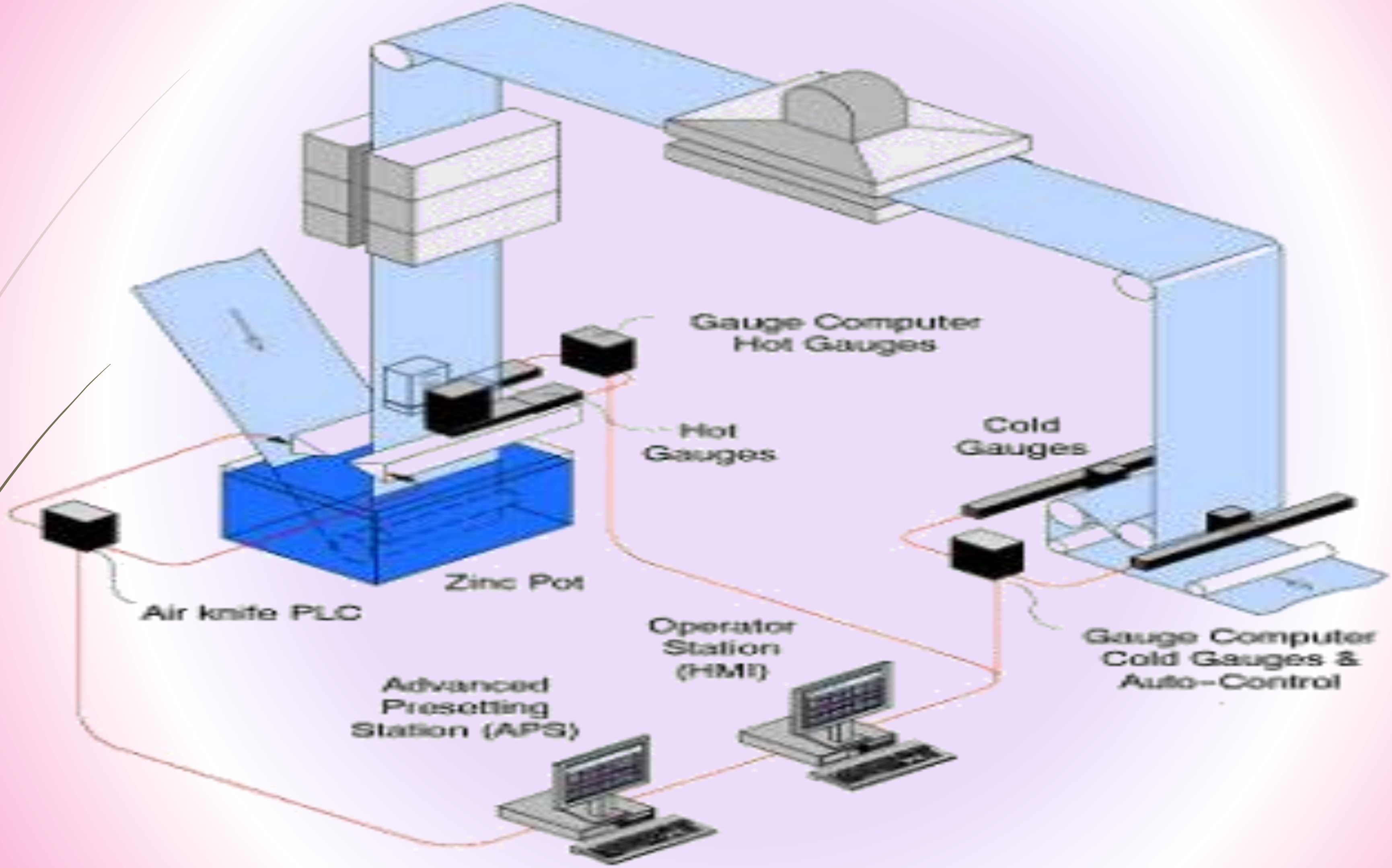

Replacing Toxic Solvent-Based Adhesives With Nontoxic Water-Based Adhesives at Blueminster Packaging Plant, Kent, UK

- When solvent-based adhesives were used at blueminster, UK, the components of the adhesive, normally a polymer and a resin (capable of becoming tacky) were dissolved in a suitable organic solvent. The adhesive film was obtained by laying down the solution and then removing the solvent by evaporation. In many adhesives, the solvent was a volatile organic compound (VOC) that evaporated to the atmosphere, thus contributing to atmospheric pollution. The cleaner production process here involves the use of water based adhesives to replace the solvent-based adhesives.
- In comparison with the solvent based adhesives, the water-based adhesives are nontoxic, nonpolluting, nonexplosive, nonhazardous, require only 20–33% of recovery systems nor explosion-proof process equipment, and are particularly suitable for food packaging. The economic benefits are derived mainly from the lack of use of solvents and can amount to significant cost savings on equipment, raw materials, safety precautions, and overheads. The drying energy, require no special solvent

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Recycling of Hazardous Wastes as Waste-Derived Fuels at Southdown, Inc., Houston, Texas, United States

- Southdown, Inc., engages in the cement, ready-mixed concrete, concrete products, construction aggregates, and hazardous waste management industries throughout the United States. According to Southdown, they are making a significant contribution to both the environment and energy conservation through the utilization of waste-derived fuels as a supplemental fuel source.
- Cement kiln energy recovery is an ideal process form anaging certain organic hazardous wastes. The burning of organic hazardous wastes as supplemental fuel in the cement and other industries is their engineering approach. By substituting only 15% of its fossil fuel needs with solid hazardous waste fuel, a modern dry-process cement plant with an annual production capacity of 650,000 tons of clinker can save the energy equivalent of 50,000 barrels of oil (or 12,500 tons of coal) a year.
- Southdown typically replaces 10–20% of the fossil fuels it needs to make cement with hazardous waste fuels. Of course, by using hazardous waste fuels, the nation's hazardous waste (including infections waste) problem is at least partially solved with an economic advantage.

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Bioassay of Industrial Waste Pollutants

- At present the risk assessment of contaminated objects is mainly based on the chemical analyses of a priority list of toxic substances. This analytical approach does not allow for mixture toxicity, nor does it take into account the bioavailability of the pollutants present. In this respect, bioassays provide an alternative because they constitute a measure for environmentally relevant toxicity, that is, the effects of bioavailable fraction of an interacting set of pollutants in a complex environmental matrix.

Advantages of use bioasssay

The use of bioasssay in the control strategies for chemical pollution has several advantages over chemical monitoring.

- First, these methods measure effects in which the bioavailability of the compounds of interest is integrated with the concentration of the compounds and their intrinsic toxicity.
- Secondly, most biological measurements form the only way of integrating the effects on a large number of individual and interactive processes.

Biological toxicity

- Biological toxicity tests are widely used for evaluating the toxicants contained in the waste. Most toxicity bioassays have been developed for liquid waste.
- Applications of bioassays in wastewater treatment plants fall into four categories:
  - use of bioassays to monitor the toxicity of wastewaters. These screening tests should be useful for pinpointing of toxicants entering the wastewater treatment plant.
  - the use of these toxicity assays in process control to evaluate pretreatment options for detoxifying incoming industrial wastes.
  - the application of short-term microbial and enzymatic assays to detect inhibition of biological processes used in the treatment of wastewaters and sludges.
  - the use of these rapid assays in toxicity reduction evaluation (TRE) to characterize the problem toxic chemicals.

References

- ***Handbook of Industrial and Hazardous Wastes Treatment -Lawrence K.Wang ,et.al.***

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Thank you