

# Waste to Wealth

**Presentation by  
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# Introduction

- Necessity is the mother of invention. Similarly scarcity is the mother of water conservation and reuse. People do something only when they start feeling the shortage. Self-motivation is the other route for achieving desirable ends and is often the best form of regulation and control.
- National Association of Manufactures USA, reported from a survey some years ago that potential for reuse in industries is from 15% to 52%, mostly from the direct reuse of cooling water and wash water. The potential for direct reuse for pulp and paper industry is 52%, whereas for chemicals and drug industry is 35% and for Textile industry is 15%.

# Introduction

- Cleaner manufacturing process have been developed over the year producing less and less waste water than in the past. Indian experience has also developed in the same directions, moving step-wise over the years as follows :
- Plain water conservation
- Reuse without any treatment
- Reuse after treatment using on site toilet water and some easily treatable industrial waste water
- Reuse after treatment using offsite sources of municipal waste water
- Interestingly, all reuse in India has been achieved at affordable cost and some industries have, in fact save the money by reusing their waste water.

# Introduction

- The growth of waste market increasing resources scarcity and availability of new technologies are offering opportunities for greening the waste water. Greening the waste sector includes in 1<sup>st</sup> Phase, the minimization of the waste. Where waste cannot be avoided, recovery of the materials and energy from the waste as well as manufacturing and recycling the waste into usable product should be second option.
- Greening of the waste sector requires financial, economic incentives, policy and regulatory measures and institutional arrangements. Cost recovery from improved waste management and avoided environmental and health cost can help reduces financial pressure on Government. Private Sector participation can also significantly reduce the costs as well as enhance the service delivery.

# Introduction

- In this paper attempts are done to recover by-products, as well as resources from waste water material from various industries like pulp and paper, pharmaceutical, chemicals, dye and dye-intermediate, agro base industry, tyre industry and refineries. It can be seen that recovery of the by product and other recourses definitely increasing the profit of the industry by way of increasing the yield of the product, reducing the waste, recycling of the waste, heat/ electrical energy recovery and also trading of the waste water. This recovery useful chemical/material has also given up carrier developing of young Environment Engineer/ Chemist as well as consultant in this field.

## Recovery of By-Product

- In the Dyes-Dye Intermediate industry particularly in the manufacturing of Fast Red B Base (2-Amino 5 – Nitro Anisole) By-Product get the recovery of Fast Scarlet R - Base (i.e. 4 Nitro Ortho Anisole). The molecular weight of the both the Red B and Scarlet R Base is the same i.e. 168 and chemical formula is also same.  $C_7H_8N_2O_3$ . Whereas, colour of the Red B is bright orange powder and the Scarlet are is bright golden yellowish powder. The economics of the has increased due to the recovery of the by-product. Otherwise the said by-product was being discharge in the effluent f the Red-B. The cost of treatment of the effluent of Red-B and the cost of the disposal of the Hazardous Waste has also eliminated due to recovery of the by-product.

# Recovery of By-Product

- In the Pulp and Paper industry. In the black liquor generated from Bagasse Pulping. The caustic (sodium hydroxide) is recovered as a by-product and used for captive consumption due to which there is no need to purchase fresh caustic from the market. This increases the economy of the industry and also reduces the pollution load. Lignin is the measure constituent of the waste water from the pulping process, which is non-biodegradable in nature. In the bleaching process, the waste water contains absorbable organic halides in addition to lignin due to which the use of chlorine as a bleaching agent. To avoid the formation of such toxic compounds, chlorine-free bleaching is encouraged in several pulp and paper mills.

# Recovery of By-Product

- Black liquor is already practiced for energy recovery in most of the large scale industries due to its good calorific value. Besides, wastewater sludge can also be co-utilised for energy recovery with fossil fuels. Using such 'biomass rich' waste materials, greenhouse gas emissions from the industry can be suppressed significantly. Alternatively, these materials can be subjected to other advanced thermal processes like gasification, pyrolysis and wet air oxidation. Pulp and paper sludge as well as boiler ash can be used as low cost adsorbents in water and wastewater treatment plants after proper treatment.

# Recovery of Resources Material from the Waste Water

- Ethanol and biodiesel production and its usage in Canada are increased from less than 200 MT in 1990 to 1,777 MT in 2010. There are 16 commercial ethanol plants in Canada either operating or under construction in 2010. The feedstock for biodiesel plants is usually animal fats; alternative feedstock includes used vegetable oil and tallow. In western Canada (Manitoba, Saskatchewan, and Alberta), the usual feedstock for biodiesel is oil derived from canola. Gasification allows thermochemical conversion of heterogeneous feedstock into a consistent synthetic gas (syngas) which can be used as a fuel for power generation or as a feedstock for production of fuels and chemicals.

# Recovery of Resources Material from the Waste Water

- Sustainable value-addition of agro-industrial wastes into bio-products and their application.
- Brewery spent grain (BSG), lignocelluloses agricultural wastes; food and vegetable liquid and solid wastes; and agro-processing wastes are the agro-industrial wastes which are either treated or disposed abundantly into landfills in Canada. These lignin and cellulose rich agro-industrial wastes have a big potential in the production of multiple bio-products, such as enzymes, bio-pesticides, bio-fertilizers, bio-control agents and bio-energy by supplying economical source of raw material.
- In the manufacture of alum particularly from the waste sulphuric acid – The sulphuric acid is utilized from the waste by –product from the fertilizer industry /chemical industry. The neutralization cost of sulphuric acid as well as the sludge handling and treatment being a Hazardous Waste is also costly matter. But reusing of the waste sulphuric acid from the manufacture of the alum is more useful and reducing the pollution load as well as getting the useful product.

# Conservation of Other Resources besides Water

Resources recovery in industries where some product is recovered alongwith reusable water can be seen in the following :

- **Steam recovery in industries :-** The most common form of reuse done in industries is steam recovery because both water and heat are recovered.
- **Fermentation Industry :-** Several plants of this type exist in India using anaerobic digestion (in the form of UASB', Bacardi and other processes) to generate bio-gas from high BOD wastewaters followed by further treatment for land irrigation or river discharge. Thus, water reuse is achieved alongwith fuel conservation.
- **Leather Industry :-** In the leather industry, chromium has been shown to be economically recoverable for reuse. Chromium removal also helps safe disposal of the sludge from the treatment plant and makes some reuse possible.
- **Pulp and Paper Industry :-** A pulp and paper mill in Pune achieved considerable savings in fuel usage through bio-gas production from their pulp-mill wastewaters.

# Industrial reuse to meet chronic water shortages

Industrial reuse to meet chronic water shortages in India first began in Mumbai, in 1964. Reuse began with plain conservation and progressively developed into more and more complicated methods, as described below :

- **Plain water conservation** came first in the textile industry in Mumbai where the survey was carried out for 22 textile mills and showed that 15-20% water could be reused directly without any treatment. One had to find out the manufacturing steps from which the wastewater could be just held in a tank and recycled in other processes where quality was not important. Higher percentage of reuse was possible if the wastewaters were pre-treated and then reused.

# Industrial reuse to meet chronic water shortages

- **Tertiary Treatment using sewage**
- The toilet waters were given tertiary treatment in the basement of these buildings and the treated waters pumped up for reuse as make-up waters for cooling towers of central A/C plants. Provision of centralized A/C thus became possible for the whole building in case of prestigious buildings in spite of water shortage, like in the Air India Bldg at Nariman Point, Mumbai, where it was first done.
- Operating costs at that time worked out to Rs.5 to 8 per 1,000 litres. This made reuse water cheaper than fresh municipal water, and more assured. Some plants over 35 years old, have now been renovated retaining the old processes.
- For larger consumers like factories, sewage was taken from municipal sewers and tertiary treatment given. This again started first in Mumbai in 1968 with the Union Carbide factory at Chembur where the author's group developed the treatment process.
- Years later, two more tertiary treatment plants came up in Chennai for Madras Refineries and Madras Fertilizers, using more concentrated Chennai sewage and later one more plant came up in Mumbai for Rashtriya Chemicals and Fertilizers (RCF) at Chembur. They all gave reusable water at costs ranging from Rs.12/- upto as much as Rs.35/- per 1000 L depending on the nature of the original wastewater and the more elaborate treatment required.

## A 3.0 MLD Pilot Plant at Vadodara, Gujarat

- This plant uses highly polluted wastewater from the so-called “effluent disposal channel” into which several industries (such as refineries, fertilizers, petrochemicals) discharge their raw wastes, showed that at least 75 per cent of the wastewater could be made reusable at opening cost of Rs.36/1000 litres, (1999 costs). The remaining 25 per cent constituted ‘rejects’ from the R.O. Plant and sludge which would need to be disposal of separately. The disposal of rejects from the RO units often remains a problem in such schemes.

Wastewater from Effluent Channel → Chem-feeds (Lime, Polyelec, Soda Ash → Clarification → HCl → Press Filtration → Sod. Bisulf → Cartridge Filtr. → Reverse Osmosis → Degasser to Remove CO<sub>2</sub> → For Reuse.

- In the case of large industries with reuse plants based on off-site sewage supplies, the cost/benefit ratios can be very variable from case to case. One way to keep the costs low is to use either less polluted wastewaters (e.g. Certain wash-waters, canteen waters, other gray waters from the industry) or more readily treatable wastewaters from public sewers (e.g., sewers carrying predominantly domestic sewage, free from industrial wastes) so that treatment is less complicated. Otherwise, the cost of water reclamation for reuse tends to get closer to desalination of sea water.

# Pollution Allowance

- Pollution allowance or emission rights, government-issued permit to emit a certain amount of a pollutant. The holder of the permit may use it to pollute legally, may trade permits, or may sell the permit for a profit. The allowance issued to a polluter is reduced over time as permitted levels of a pollutant are cut. By specifying reductions in emissions but leaving the polluter to decide how to cut them, the system is intended to provide free-market incentives to lessen both pollution (principally acid rain) and compliance costs. A company that cuts its pollution below its permitted level may sell the surplus allowance; a company that exceeds its limits without purchasing an extra allowance is fined. Under the Clean Air Act of 1990, federal allowances for sulfur dioxide emissions are issued to polluters, and additional allowances are auctioned. Usually bought by companies, allowances are sometimes purchased by environmentalists who retire them in order to reduce overall emissions. Sponsored by the Environmental Protection Agency and run by the Chicago Board of Trade, the first U.S. air pollution auction was held in 1993. While many have praised the system's innovative market-driven approach to the problem of environmental pollution, critics question its monitoring provisions and raise the possibility that it may merely shift pollution from one region to another. Under the 1997 Kyoto Protocol on greenhouse gases (as amended in 2001; effective 2005; extended to 2020 in 2012), nations that emit fewer such gases than permitted under the accord may sell their surplus emission rights to other nations.

# **Development of Categories of Hazardous Waste**

# **18 Categories of Hazardous Waste as per 28<sup>th</sup> July 1989 MoEF Notification Hazardous Waste (Management and Handling) Rules, 1989**

- The “Hazardous Waste Management and Handling Rules” of December 1989 was aimed at solid and semisolid hazardous wastes generated by 18 categories of industries potentially producing toxic, flammable, reactive, and corrosive wastes, in solid, sludge as well as fluid phases. For example : Waste Category No.15 addressed pesticides and herbicides, their residues and intermediates (regulatory quantities : over 5 kg/yr cumulative). The rules provided so called “cradle to grave” guidelines for generators, transporters, operators of disposal facilities, and the state governments regarding monitoring .

# List of 18 Categories is as below :

## SCHEDULE

[See rules 3 (i), 3(n) and 4]

### CATEGORIES OF HAZARDOUS WASTES

<b>Waste Categories</b>	<b>Type of wastes</b>	<b>Regulatory Quantities</b>
<b>1</b>	<b>2</b>	<b>3</b>
Waste Category No. 1	Cynide Waste	1 kilogrammes per year calculated as cynide.
Waste Category No. 2	Metal Finishing Wastes	10 kilogrammes per year the sum of the specified substance calculated as pure metal.
Waste Category No. 3	Waste containing water soluble chemical compounds of lead, copper, zinc, chromium and antimony.	10 kilogrammes per year the sum of the specified substance calculated as pure metal.
Waste Category No. 4	Mercury, Arsenic, Thallium and Cadmium bearing wastes.	5 kilogrammes per year the sum of the specified substance calculated as pure metal.
Waste Category No. 5	Non-halogenated hydrocarbons including solvent.	200 kilogrammes per year calculated as non-halogenated hydrocarbons.
Waste Category No. 6	Halogenated hydro-carbon including solvents	50 kilograms per year calculated as helogenated hydrocarbons.

# List of 18 Categories is as below :

Waste Category No. 7	Wastes from paints, pigments, glue, varnish and printing ink.	250 kilogrammes per year calculated as oil or oil emulsions.
Waste Category No.8	Wastes from Dyes and Dye intermediate containing inorganic chemical compounds.	200 kilogrammes per year calculated as inorganic chemicals.
Waste Category No. 9	Wastes from Dyes and Dye intermediate containing organic chemical compounds.	50 kilogrammes per year calculated as organic chemicals.
Waste Category No. 10	Waste oil and oil emulsions.	1000 kilogrammes per year calculated as oil and oil emulsions.
Waste Category No. 11	Tarry wastes from refining and tar residues from distillation or prolytic treatment.	200 kilogrammes per year calculated as tar
Waste Category No. 12	Sludges arising from treatment of waste waters containing heavy metals, toxic organics, oils emulsions and spend chemical and inceneration ash.	irrespective of any quantity.
Waste Category No. 13	Phenols.	5 kilogrammes per year calculated as phenols.
Waste Category No. 14	Asbestos.	200 kilogrammes per year calculated asbestos.

## List of 18 Categories is as below :

Waste Category No. 15	Wastes from manufacturing of pesticides and herbicides and residues from pesticides and, herbicides formulation units.	5 kilogrammes per year calculated as pesticides and their intermediate products.
Waste Category No. 16	Acid/Alkaline/Slurry	200 kilogrammes per year calculated as Acids/Alkalies.
Wastes Category No.17	Off-specification and discarded products.	Irrespective of any quantity.
Wastes Category No.18	Discarded containers and Containers linears of hazardous and toxic wastes.	Irrespective of any quantity.

# List of 44 Categories is as below :

## SCHEDULE - 1

[ See rule 3(i)(a) ]

### List of processes generating hazardous wastes

S.No.	Processes	Waste streams	
1.	Petrochemical processes and pyrolytic operations	1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 1.10 1.11	Oven debris Oil -containing bleaching earth Acid tar Sulphur-containing residue from sulphur removal oil-containing sludge oil emulsion oil-containing acid tar residue made with coal tar sludge from waste water purification residual liquid and paste-like organic substances made with aromatic, aliphatic and naphenic hydrocarbons residue from alkali wash of fuels
2.	Natural gas production	2.1 2.2 2.3	mercury-containing sludge mercury-containing filter material sulphur-containing residues

# List of 44 Categories is as below :

- Later on MoEF, GoI published in the : “Gazette of India, Extraordinary, Part II-Section 3, Sub-Section (ii) vide a No. S.O. 10(E)” dated January 8, 1999, under powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986); invited objections from persons likely to be affected within a period of 60 days with regards to the intention of GoI to amend HW&M Rules of 1989. The committee chaired by Dr. Sivaram National Chemical Laboratory, Pune, received a total of 48 objections and responses. Subsequently, in exercise of the powers conferred by sections 6, 8, 25 of the Environment (Protection) Act, 1986; the GoI notified the amendments to the HWM&H Rules on January 6, 2000. These rules referred to as the “Hazardous Waste (Management and Handling) Amendment Rules, 2000” have come into force on the date of publication in the official gazette. The definition of the term “hazardous waste” has been broadened in the amendments. The Scedule-1 appended to the HWM&H Amendment Rules of 2000, lists 44 processes generating hazardous wastes along with a detailed sub-listing of the potential waste streams (totally 127).

# List of 44 Categories is as below :

- It is important to note above schedules, the term “hazardous waste” has also been defined in the context of import and export of waste substances as described in Rules 12, 13, and 14 of the HWM&H Amendment Rules of 2000. Part-A of Schedule-3 lists importable and exportable wastes (List “A” & “B”) and Part-B of the Schedule lists the hazardous characteristics. It is important to note that, the amendment now permits import of waste substances (listed in Part-A of Schedule-3) for the purpose of reuse and recycle only when the waste does not have characteristics listed in Part-B of Schedule-3. Clearly, some new matrices will now be taken in the fold of HW regulation as a result of categories put forth by the HWM&H Amendment Rules, 2000. Disposable parts such as filter cartridges, filter cloths, air filters, ion exchange resins, molecular sieves, spent catalysts, etc are also categorically covered under new listing although the production of these matrices may strictly be aperiodic, need based, and episode in nature. In the HWM&H Rules of 1989, there was room for ambiguous interpretation of “Category 12 : ETP sludges” because majority of chemical and manufacturing units have oil and grease, trace metals, toxic organics, and spent chemicals mixed into the process water. This is also precisely the reason for their establishing ETP. Thus, sludges generated by ETP in many instances were included, across the board, in hazardous waste inventorisation.

## **List of 44 Categories is as below :**

- According to rule 5, the SPCB is expected to process authorisation application for disposal of hazardous waste within 90 days. The authorization period has been extended from two years to five years. The newly introduced sub-rule (8) links renewal of authorisation granted under sub-rule (6) with steps to be taken by occupier or operator of the facility for reduction in the waste generated or recycle or reused.

# List of 44 Categories is as below :

3.	Production or use of zinc, <b>zinc oxide</b>	3.1	zinc ashes
<b>3.bis</b>	<b>Production and use of copper oxide, copper including Electro-refining and Electro-winning operations</b>	<b>3.1bis 3.2bis 3.3bis 3.4bis</b>	<b>Dust and residues from gas cleaning system of copper smelters Spent electrolytic solutions from copper, electrorefining and electrowinning operations Wastes sludges, excluding anode slimes from electrolyte purification systems Other exhaust dust.</b>
4.	Production or use of lead	4.1 4.2 4.3	lead ashes lead slags lead-containing filter material
5.	Production or use of cadmium	5.1	cadmium-containing filter material
6.	Production or use of arsenic	6.1	arsenic-containing filter material
7.	Production of cast iron	7.1	<b>cupola oven dust*</b>
8.	Production of crude <b>iron</b> and steel with oxy-steel converters or electro-ovens	8.1 8.2	<b>Process dust Benzol Acid Sludge</b>

# List of 44 Categories is as below :

9.	Production of aluminium (primary or secondary production)	9.1 9.2 9.3	<b>filtered</b> material cathode residues overn debris
10.	Non-ferro metallurgical processes	10.1	heavy metal-containing oven debris arsenic chalk
11.	Hardening of steel	11.1 11.2	cyanide-, nitrate-, or nitrite- containing sludge hardening salt
12.	Production of asbestos or asbestos-containing materials <b>and or products</b>	12.1	asbestos-containing residue
13.	Production of chlorine by means of <b>mercury</b> /diaphragm-electrolyses process	13.1 <b>13.2</b>	Asbestos-containing <b>discards</b> <b>Mercury bearing sludge</b>
14.	Phenol production	14.1	Phenol mixture
15.	Metalworking	15.1 15.2	Selenium-containing metal waste Beryllium-containing metal waste

# List of 44 Categories is as below :

16.	Metal surface treatment, such as etching, staining, polishing, galvanising, cleaning, degreasing and hot dip galvanising	16.1 16.2 16.3 16.4 16.5 16.6 16.7 16.8	Acid, acid residue or acid mixture Alkali, alkali residue or alkali mixture Galvanic bath and (half-) concentrate made with sulphide, chromium (VI), cyanide, copper, zinc, cadmium, nickel or tin Halogen-free sludge from a bath which used organic solvents Halogen-containing sludge from a bath with organic solvents Phosphating sludge Halogen-containing organic degreasing bath sludge from staining bath
17.	Treatment of <b>galvanising</b> and similar with baths and water purification in metal surface treatment	17.1 17.2 17.3	metal hydroxide sludge chromium, cadmium copper, zinc, nickel or silver heavy metal-containing eluate from ion exchangers heavy metal-containing half-concentrates from membrane systems
18.	Production of acids <b>and fertilizer</b>	18.11 <b>8.2</b> <b>18.3</b>	acid-containing residues <b>spent catalyst</b> <b>Sulphur containing residue</b>

# List of 44 Categories is as below :

19.	Production or use of solvents	19.1 19.2 19.3 19.4 19.5 19.6 19.7	contaminated halogen-free aromatic, aliphatic or naphthenic solvents contaminated halogen-free solvents made with phenols, ketones, ethers, acetates, alcohols, or glycols contaminated halogen-containing aromatic, aliphatic or naphthenic solvents contaminated halogen-containing solvents made with phenols contaminated solvents or mixtures of solvents made with organic nitrogen containing aromatics, naphthenes of aliphatics contaminated solvents or mixtures of solvents made with organic sulphur compounds distillation residue
20.	Removal of coatings from ships, bridges and locks, electricity pylons and road markings by blasting	20.1	blasting material contaminated with coating residues
21.	Production or use of coatings paints, lacquers, varnishes and plastics, and of inks	21.1 21.2	residues of coatings or such as inks if not completely hardened sludge from waste water purification in production processes

# List of 44 Categories is as below :

22.	Production or use of glues, cements, adhesive and resins	22.1 22.2	glue, cement or adhesive residue (not made with vegetable or animal materials) if not completely dried out resin oil residue
<b>22bis.</b>	<b>Production or use of dyes, dye-intermediates and pigments</b>	<b>22.1bis</b> <b>22.2bis</b>	<b>Process sludge</b> <b>Sludge from waste water treatment</b>
23.	Production or use of latex	23.1	latex or latex emulsion residue if not completely polymerised or coagulated
24.	Production or use of paint removers	24.1	paint remover residue
25.	Printing and copying with liquid toner	25.1 25.2 25.3 25.4 25.5 25.6 25.7 25.8	printing ink residue silkscreen printing ink residue lacquer residue liquid toner residue residue of cleaning agents made with organic solvents etching fluid residue dispersive oil residue oxidising agent residue
26.	Production or use of photo-chemicals	26.1 26.2 26.3	developer residue fixer residue bleaching fixer residue

# List of 44 Categories is as below :

27.	Production or use of organic peroxides	27.1	organic peroxide residue
28.	Production or use of halogen-containing hydrocarbons or of aromatic, aliphatic or naphthenic hydrocarbons	28.1	residue of fluid or pasty organic materials
		28.2	made with halogen-containing hydrocarbons residue of fluid or pasty organic materials made with aromatic, aliphatic or naphthenic hydrocarbons
29.	Production or use of organic, nitrogen <b>or oxygen compounds</b>	29.1	residue of fluid or pasty organic materials made with oxygen compounds organaic nitrogen or oxygen compounds (other than vegetable or animal carbohydrates, proteins, fats and fatty acids)
30.	Production or use of materials made with silicones	30.1	silicone oil residue
		30.2	silicone-containing residues
31.	Production of canvas and textiles	31.1	textile chemical residue

# List of 44 Categories is as below :

32.	Production or use of plastics or raw materials for them	32.1 32.2 32.3 32.4 32.5 32.6 32.7 32.8 32.9	halogen-free residue of additives for plastics (e.g. dyestuffs, stabilisers, or flame retardants) halogen-containing residue of additives for plastics halogen-free residue of plasticisers for plastics halogen-containing residue of plasticisers for plastics residue from the preparation of vinylchloride monomer residue from the preparation of acrylonitrile monomer residue of liquid or pastry rubber emulsion or rubber solution if not polymerised sludge from waste water purification from rubber production if not polymerised PVC-containing residues if not polymerised
33.	Production of cosmetics	33.1	Residue of chemical raw materials and additives (other than vegetable and animal carbohydrates, proteins, fats and fatty acids)
34	Production, of pharmaceuticals	34.1	Residues from the production of medicines (other than vegetable and animal carbohydrates, proteins, fats and fatty acids)

## List of 44 Categories is as below :

35.	Production, formulation of pesticides	35.1 35.2 35.3 35.4	pesticide residues sludge from waste water treatment hexa or hexa-containing residue made with hexa-chlorocyclohexane or hexachloro benzene residues from the use of pesticides
36.	Production, formulation or use of wood preservatives	36.1 36.2 36.3 36.4	production and formulation residue sludge from the waste water purification residue from the use of wood preservatives wood alkali bath
37.	Cleaning, emptying and maintenance of tanks and separators of vessels vehicles and of mobile and stationary storage tanks, washing water	37.1 37.2 37.3	oil-containing cargo residue, washing water and sludge chemical-containing cargo residue and sludge oil-water sludge mixture and oil-containing air filters from oil, fat, sludge or petrol separation
38.	Cleaning of barrels which have held chemical substances	38.1 38.2	chemical-containing residue from barrel cleaning sludge from waste water purification
39.	Purification procession for air and water	39.1 39.2 39.3 39.4	sludge from waste water treatment from artificial fertilizer production sludge from the treatment of waste water containing hydrofluoric acid heavy metal-containing residue from used-ion exchange material in the water purification flue gas cleaning residue

# List of 44 Categories is as below :

40.	Purification procession for organic water	40.1	filters and filter material which have organic liquids on them, e.g. mineral oil, synthetic oil and organic chlorine compounds
41.	Waste treatment processes, e.g. incineration, distillation and separation and concentration techniques	41.1 41.2 41.3 41.4 41.5	sludge from the incineration of exclusively chemical waste fly ash from incineration of <b>hazardous</b> waste, except exclusively communal sewage sludge, flue gas cleaning residue battery acid distillation residue from the work-up of contaminated halogen-free organic solvents distillation residue from the work-up of contaminated halogen-containing organic solvents
42.	<b>Tanning of leather</b>	42.1 <b>42.2</b>	<b>Chromium (vi) bearing residue</b> <b>Chromium bearing sludge</b>
43.	Performance of maintenance and repair work on vehicles and	43.1 43.2	oil-containing sludge and oil emulsion filters and filter material which have organic liquids on them, e.g. mineral oil, synthetic oil and organic chlorine compounds
44.	Every action relating to and every use of lubricating and system oil	44.1 44.2	spent oil other spent lubricating and system oil

## **List of 36 Categories is as below :**

- As per the Hazardous Waste Management, Handling and Trans boundary Movement Rules 2008 issued on 24<sup>th</sup> September 2008, the 44 categories are now reduced upto 36 categories.

# List of 36 Categories is as below :

## Schedule I

[See rules 3 (1)]

### List of processes generating hazardous wastes

S.No.	Processes	Hazardous Waste *
1.	Petrochemical processes and pyrolytic operations	1.1 Furnace/reactor residue and debris 1.2 Tarry residues 1.3 Oily sludge emulsion 1.4 Organic residues 1.5 Residues from alkali wash of fuels 1.6 Still bottoms from distillation process 1.7 Spent catalyst and molecular sieves 1.8 Slop oil from wastewater
2.	Drilling operation for oil and gas production	2.1 Drill cuttings containing oil 2.2 Sludge containing oil 2.3 Drilling mud and other drilling wastes
3.	Cleaning, emptying and maintenance of petroleum oil storage tanks including ships	3.1 Oil-containing cargo residue, washing water 3.2 Chemical-containing cargo residue and sludge 3.3 Sludge and filters contaminated with oil 3.4 Ballast water containing oil from ships.
4.	Petroleum refining/ re-processing of used oil/recycling of waste oil	4.1 Oily sludge/emulsion 4.2 Spent catalyst 4.3 Slop oil 4.4 Organic residues from process 4.5 Spent clay containing oil

# List of 36 Categories is as below :

5.	Industrial operations using mineral/synthetic oil as lubricant in hydraulic system or other applications	5.1 Used/spent oil 5.2 Wastes/residues containing oil
6.	Secondary production and/or industrial use of zinc	6.1 Sludge and filter press cake arising out of production of Zinc Sulphate and other Zinc Compounds. 6.2 Zinc fines/dust/ash/skimmings (dispersible form) 6.3 Other residues from processing of zinc ash/skimmings 6.4 Flue gas dust and other particulates
7.	Primary production of zinc/lead/copper and other non-ferrous metals except aluminium	7.1 Flue gas dust from roasting 7.2 Process residues 7.3 Arsenic-bearing sludge 7.4 Non ferrous metal bearing sludge and residue. 7.5 Sludge from scrubbers
8.	Secondary production copper	8.1 Spent electrolytic solutions 8.2 Sludges and filter cakes 8.3 Flue gas dust and other particulates
9.	Secondary production of lead	9.1 Lead bearing residues 9.2 Lead ash/particulate from flue gas

## List of 36 Categories is as below :

10.	Production and/or industrial use of cadmium and arsenic and their compounds	10.1 Residues containing cadmium and arsenic
11.	Production of primary and secondary aluminium	11.1. Sludges from off-gas treatment 11.2. Cathode residues including pot lining wastes 11.3. Tar containing wastes 11.4. Flue gas dust and other particulates 11.5. Wastes from treatment of salt slags and black drosses
12.	Metal surface treatment, such as etching, staining, polishing, galvanising, cleaning, degreasing, plating, etc.	12.1 Acid residues 12.2 Alkali residues 12.3 Spent bath/sludge containing sulphide, cyanide and toxic metals 12.4 Sludge from bath containing organic solvents 12.5 Phosphate sludge 12.6 Sludge from staining bath 12.7 Copper etching residues 12.8 Plating metal sludge

## List of 36 Categories is as below :

13.	Production of iron and steel including other ferrous alloys (electric furnaces; steel rolling and finishing mills; Coke oven and by product plant)	13.1 Sludge from acid recovery unit 13.2 Benzol acid sludge 13.3 Decanter tank tar sludge 13.4 Tar storage tank residue
14.	Hardening of steel	14.1 Cyanide-, nitrate-, or nitrite-containing sludge 14.2 Spent hardening salt
15.	Production of asbestos or asbestos-containing materials	15.1 Asbestos-containing residues 15.2 Discarded asbestos 15.3 Dust/particulates from exhaust gas treatment.
16.	Production of caustic sods and Chlorine	16.1 Mercury bearing sludge 16.2 Residue/sludges and filter cakes 16.3 Brine sludge containing mercury
17.	Production of mineral acids	17.1 Residues, dusts or filter cakes 17.2 Spent catalyst
18.	Production of nitrogenous and complex fertilizers	18.1 Spent catalyst 18.2 Spent carbon 18.3 Sludge/residue containing arsenic 18.4 Chromium sludge from water cooling tower
19.	Production of phenol	19.1 Residue/sludge containing phenol

## List of 36 Categories is as below :

20.	Production and/or industrial use of solvents	20.1 Contaminated aromatic, aliphatic or naphthenic solvents may or may not be fit for reuse. 20.2 Spent solvents 20.3 Distillation residues
21.	Production and/or industrial use of paints, pigments lacquers, varnishes, plastic and inks	21.1 Process wastes, residues & sludges 21.2 Fillers residues
22.	Production of plastic raw Materials	22.1 Residues of additives used in plastics manufacture like dyestuffs, stabilizers, flame retardants, etc. 22.2 Residues and waste of plasticisers 22.3 Residues from vinylchloride monomer production 22.4 Residues from acrylonitrile production 22.5 Non-polymerised residues
23.	Production and/or industrial use of glues, cements, adhesive and resins	23.1 Wastes/residues (not made with vegetable or animal materials)
24.	Production of canvas and textile	24.1 Chemical residues
25.	Industrial production and formulation of wood preservatives	25.1 Chemical residues 25.2 Residues from wood alkali bath
26.	Production or industrial use of synthetic dyes, dye-intermediates and pigments	26.1 Process waste sludge/residues containing acid or other toxic metals or organic complexes 26.2 Dust from air filtration system

# List of 36 Categories is as below :

27.	Production of organo-silicone Compounds	27.1 process residues
28.	Production/formulation of drugs/pharmaceuticals & health care product	28.1 Process Residues and wastes 28.2 Spent catalyst/spent carbon 28.3 Off specification products 28.4 Date-expired, discarded and off-specification drugs/medicines 28.5 Spent organic solvents
29.	Production, and formulation of pesticides including stock-piles	29.1 Process wastes/residues 29.2 Chemical sludge containing residue pesticides 29.3 Date-expired and off-specification pesticides
30.	Leather tanneries	30.1 Chromium bearing residues and sludges
31.	Electronic Industry	31.1 Process residues and wastes 31.2 Spent etching chemicals and solvents
32.	Pulp & Paper Industry	32.1 Spent chemicals 32.2 Corrosive wastes arising from use of strong acid and bases 32.3 Process sludge containing adsorbable organic halides [AOx]

# List of 36 Categories is as below :

33.	Disposal of barrels containers used for handling of hazardous wastes chemicals	<p>33.1 Chemical-containing residue arising from decontamination.</p> <p>33.2 Sludge from treatment of waste water arising out of cleaning/disposal of barrels/containers</p> <p>33.3 Discarded containers/barrels/liners contaminated with hazardous wastes/chemicals</p>
34.	Purification and treatment of exhaust air, water & waste water from the processes in this schedule and common industrial effluent treatment plants (CETP's)	<p>34.1 Flue gas cleaning residue</p> <p>34.2 Spent ion exchange resin containing toxic metals</p> <p>34.3 Chemical sludge from waste water treatment</p> <p>34.4 Oil and grease skimming residues</p> <p>34.5 Chromium sludge from cooling water</p>
35.	Purification process for organic compounds/solvents	<p>35.1 Filters and filter material which have organic liquids in them, e.g. mineral oil, synthetic oil and organic chlorine compounds</p> <p>35.2 Spent catalyst</p> <p>35.3 Spent carbon</p>
36.	Hazardous waste treatment processes, e.g. incineration, distillation, separation and concentration techniques	<p>36.1 Sludge from wet scrubbers</p> <p>36.2 Ash from incineration of hazardous waste, flue gas cleaning residues</p> <p>36.3 Spent acid from batteries</p> <p>36.4 Distillation residues from contaminated organic solvents</p>

## **List of 36 Categories is as below :**

- The inclusion of wastes contained in this Schedule does not preclude the use of Schedule 2 to demonstrate that the waste is not hazardous. In case of dispute, the matter would be referred to the Technical Review Committee constituted by MoEF,

**Note:** The high volume low effect wastes such as fly ash, phosphogypsum, red mud, slags from pyrometallurgical operations, mine tailings and ore beneficiation rejects are excluded from the category of hazardous wastes. Separate guidelines on the management of these wastes shall be issued by CPCB.

# Conclusion

- It can be concluded that Pollution control is not only related to the implementation of the laws, but it is production yield increasing, reuse of the resources material and also getting the by-product which were going alongwith the effluent. Pollution control is definitely a Profit making activity in long turn period.

# References

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- 4) Information from the Internet.
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***THANKS***