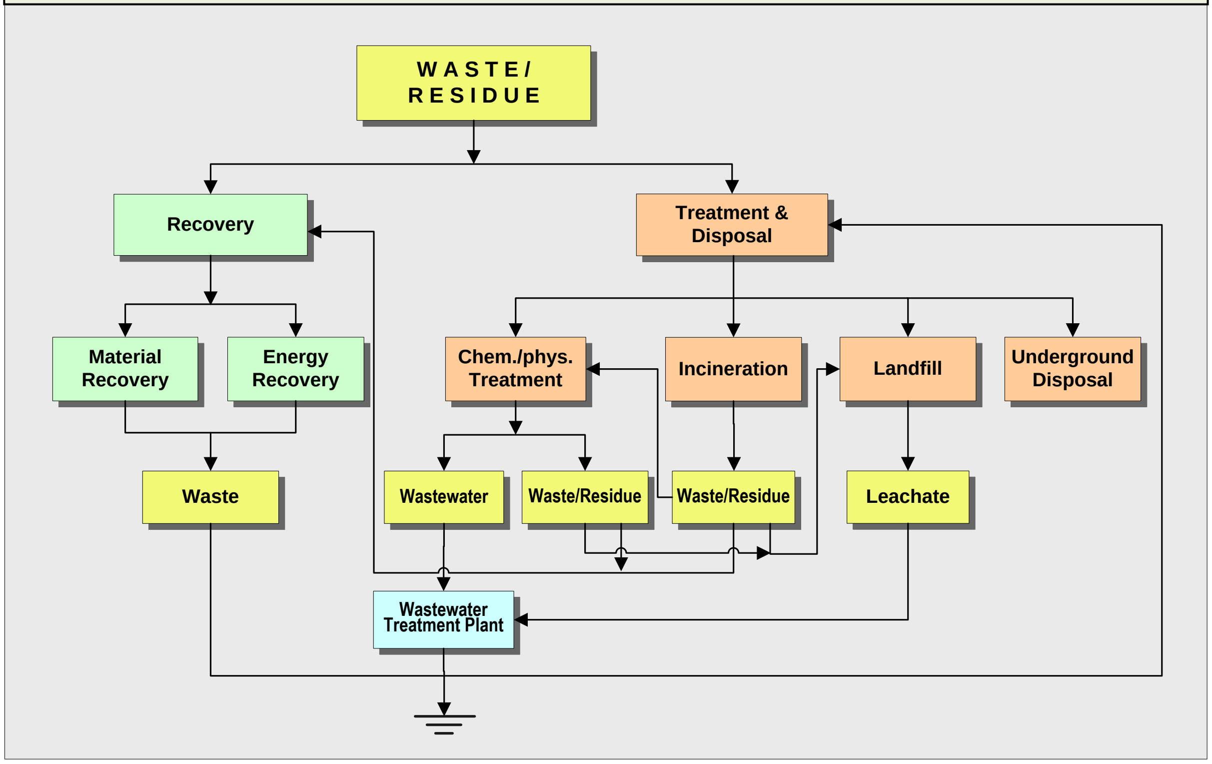
Manual on Industrial Hazardous Waste Management for Authorities in Low and Middle Income Economies



SUPPLEMENT 2:

BASEL CONVENTION WASTE Y CODE LIST AND ALLOCATION TO PHYSICO-CHEMICAL AND BIOLOGICAL TREATMENT METHODS

giz CHS Convention Project Chemical Safety

On behalf of Federal Ministry for Economic Cooperation and Development

Basel Convention waste Y code list and allocation to physico-chemical and biological treatment methods

Waste Categories and Treatment Methods

This section looks briefly at the Annex I "Y" categories, and at some of the waste types covered by them. It indicates according to the Basel Convention the classes of physicochemical and biological treatment which might find successful application for those categories.

For more detailed information see the Basel Convention technical guidelines for hazardous wastes on physico-chemical and biological treatment, available at: **http://archive.basel.int/meetings/sbc/workdoc/techdocs.html**

When referring below to guidelines relevant Basel Convention Guidelines are addressed.

Basel Category as indicated in Annex I of the guideline	Phys/ Mech Process	Chemical Process	Phys/Chem Process	Immobilisation	Bio-logical Process
Y1	x				
Y2	x	x	x		x
Y3		x		x	x
Y4	x	x	x		x
Y5	x	x	x		x
Y6	x	x	x	x	x
Y7	x	x			x
Y8	x	x			
Y9	x	x	x		x
Y10	x	x	x		x
Y11			x	x	x
Y12	x	x	x	x	x
Y13	x	x	x	x	x
Y14	x	x	x	x	x
Y15		x			x
Y16	x	x			x
Y17	x	x	x		x
Y18	x		x	x	x
Y19	x	x			
Y20	x	x		x	
Y21	x	x		x	
Y22	x	x	x	x	
Y23	x	x	x	x	
Y24	x	x		x	

Basel Category as indicated in Annex I of the guideline	Phys/ Mech Process	Chemical Process	Phys/Chem Process	Immobilisation	Bio-logical Process
Y25	x	x		x	
Y26	x	x	x	x	
Y27	x	x	x	x	
Y28	x	x		x	
Y29	x	x	x	x	
Y30	x	x	x	x	
Y31	x	x			
Y32		x	x	x	
Y33	x	x			
Y34	x	x			
Y35	x	x			
Y36				x	
Y37	x	x	x		x
Y38[1]	n/a	n/a	n/a	n/a	n/a
Y39	x	x	x		x
Y40	x		x		x
Y41	x	x	x		x
Y42	x		x		x
Y43	x	x	x	x	x
Y44	x	x	x	x	x
Y45	x	x	x		x

Y1. As the principal concern with clinical waste is the risk of exposure to infectious organisms, it is usually good practice to avoid any process which exposes wastes to the open air. Important relevant processes for treating such wastes include autoclaving and microwave/irradiation which destroy the bio-activity.

Y2. The production and preparation of pharmaceuticals will yield many types of waste. Important relevant processes will include distillation, absorption, filtration, solvent extraction, ion-exchange and evaporation of primary wastes and neutralisation, flocculation, membrane processes and biological treatment of aqueous effluents and waste waters.

Y3. Pharmaceuticals, drugs and medicines will involve a potentially wide range of organic and inorganic substances. Relevant processes could include oxidation/reduction with neutralisation for inorganic and part organic materials, dissolution and biological treatment for certain organic materials and encapsulation for small items of great difficulty.

Y4. The production, formulation and use of biocides and phytopharmaceuticals involves both inorganic and organic substances and wastes. Relevant processes may include distillation, evaporation, solvent extraction, drying, absorption and ion-exchange for primary wastes and oxidation/reduction, neutralisation, flocculation, settlement, membrane processes and biological methods for aqueous effluents and waste waters.

[1] Information is missing as not indicated in the relevant Basel Convention Guideline on physico-chemical and biological treatment.

Y5. The manufacture, formulation and use of wood preserving chemicals involves organic and inorganic substances. The concentrated chemicals themselves may typically be dealt via distillation, neutralisation, precipitation, oxidation/reduction, solidification and encapsulation. Washings and waste waters may be dealt with using neutralisation, precipitation, settlement, ion exchange, absorption, membrane concentration techniques, and biological methods.

Y6. The production of solvents involves principally organic feedstocks, but with catalysts for some of the synthetic processes. Such catalysts often contain comparatively exotic metals. Formulation and use of solvents broadens the possible range of wastes. Relevant processes applicable to the primary wastes can include distillation, evaporation, adsorption, leaching, neutralisation, precipitation, settlement, filtration, solidification and encapsulation. Waste waters and aqueous washings can include absorption, ion exchange, neutralisation, precipitation, settlement, membrane processes and biological treatment.

Y7. Cyanide based heat treatment residues will usually be solid and will need to be dissolved in water before processing. Oxidation reactions, possibly coupled with precipitation, settlement and filtration, are the most common for this material. Electrolytic and biological methods may have some application. Sometimes the waste has quenching oil associated with it, in which case some form of separation such as flotation may be required.

Y8. Waste mineral oils may be subjected to various clean-up processes leading to recovery in some form. These may range from simple settlement, through evaporation, dewatering, drying, filtration and centrifuging, to acidic scrubbing and distillation. (See Y10 for oils contaminated with PCBs etc).

Y9. Waste oil/water, hydrocarbons/water mixtures and emulsions can utilise many different processes to effect a separation and clean up. Much will depend on the ratio of oil and water and of the presence of suspended solid matter. Separation processes can include settlement with heat, chemical emulsion breaking (acidification followed by neutralisation), centrifuging, filtration, flotation and membrane processes. Clean up of the oil phase may then follow the options identified under Y8. In some cases, oil/water systems predominantly consisting of oil may be amenable to treatment by biological methods.

Y10. Waste substances and articles comprising or containing PCBs, PCTs and PBBs may be amenable to direct treatment or may be better dealt with by separating the contaminant and treating it in isolation. Contaminated waste oils and inert liquids may be treated by chemical dechlorination. Aqueous systems may be contacted with an absorbing medium to remove the PCB. Solid waste may be washed/rinsed and lose materials leached with a suitable solvent. Biological methods may be appropriate for low concentration waste waters and soils.

Y11. Physico-chemical treatments offer few practical and effective opportunities for dealing with tarry residues from refining, distillation and pyrolytic treatments. Immobilisation techniques may be helpful in some cases and there may sometimes be value in separation of components via washing/leaching methods. Biological methods may offer some scope, depending on the particular constituents present.

Y12. Wastes from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnishes are likely to be predominantly organic, although some pigments and dyestuffs may be inorganic. Processes most applicable to the organic materials include distillation, settlement, absorption evaporation, drying and filtration, together with biological and possibly membrane processes for some materials, including aqueous effluent type streams. Inorganic materials may involve filtration, flocculation/ coagulation and immobilisation techniques.

Y13. Wastes from the production, formulation and use of resins, latex, plasticisers and glues/adhesives are likely to be predominantly organic, although some inorganic substances may be encountered, especially with plasticisers. Dealing with the wastes may involve a wide range of processes, including physical separation options such as sieving and screening, air classification, size reduction etc, and distillation, filtration, centrifuging, float and sink and biological methods. Inorganic materials may involve precipitation and immobilisation techniques.

Y14. New, unidentified and unknown chemicals from research and development and teaching always pose special problems for waste management. Clearly, they can possess practically any hazard characteristic, even though it may not be known or even suspected. Quantities will often be small, making evaluation work not only expensive, difficult and risky, but impractical. Of the processes available within the scope of these Guidelines, few are really suitable unless there is some significant level of awareness of the nature and properties of the materials. Given such knowledge, practically any process may be suitable in certain circumstances, but completely unknown material in small quantities may be best dealt with by encapsulation.

Y15. Wastes of an explosive nature, not subject to specialist explosives legislation, may include both organic and inorganic materials. Hydrolysis may be appropriate, or dissolution and dispersion at non-critical levels (not a process previously listed). Biological methods may also offer prospects for organic based materials and chemical processing for inorganic ones.

Y16. Waste from the production, formulation and use of photographic chemicals etc will be mainly inorganic in nature. Separation of silver-rich paper from other material may be important, using techniques such as air classification, float and sink, and manual sorting. Liquid wastes may be treated by precipitation, neutralisation, settlement and filtration or electrolysis. Organic wastes may be suitable for distillation or biological treatment.

Y17. Wastes resulting from the surface treatment of metals and plastics can embrace a very wide range of solid powders and residues and organic and inorganic liquids and sludges. Many of the processes covered in these Guidelines can find application in some circumstances. Separation of metals and plastics from each other and from other materials can involve separation processes such as air classification, ballistic separation, sieving and screening, manual and special sorting, float and sink, flotation, magnetic separation etc. Organic materials may involve distillation, evaporation, adsorption, washing, membrane techniques and biological methods. Inorganic materials may require neutralisation, precipitation, oxidation/reduction, settlement and filtration.

Y18. Residues arising from industrial waste activities cover many types of materials, but many would be dealt with by methods other than those covered by these Guidelines. Processes which may find application include washing and leaching, magnetic separation, sieving and screening, air classification, immobilisation techniques and composting.

Y19. Metal carbonyls are invariably highly toxic and volatile and are often powerful oxidising agents. Most react with water (hydrolysis) to yield toxic and flammable vapours. As constituents of wastes, hydrolysis offers a route to degradation, but requires great caution in the control and disposal of the gases and vapours released. Precipitation, settlement and filtration may deal with the metal originally associated with the carbonyl.

Y20. Beryllium and its compounds are invariably highly toxic, particularly via inhalation of dusts and fumes. Final disposal options focus on the need to isolate and contain the material and to prevent its dispersion into the wider environment. Options relevant to these Guidelines include washing, settlement, filtration and possibly neutralisation and precipitation for separation and isolation, leading to a thickened slurry or filtercake type material. Immobilisation processes may be applicable to generate a more stable material for eventual deposit.

Y21. Hexavalent chromium compounds are generally soluble and hence impossible to precipitate from solution and remove by filtration etc. Concentration of low levels of hexavalent chromium in aqueous effluent may be achieved by ion exchange, the use of absorbents and possibly membrane techniques. Electrolytic techniques may permit chromium metal to be plated out of hexavalent solutions. Chemical processing of hexavalent solutions involves reduction of the chromium to its trivalent state, followed by neutralisation, precipitation as the trivalent hydroxide, settlement and filtration. Immobilisation techniques may afford more stability to the final residues.

Y22. Copper compounds may utilise a very wide range of relevant processes. These include separation processes such as sieving, air classification, ballistic separation, float and sink, size reduction, magnetic separation etc for slags, mixed scraps, shredded wastes and dry material generally. For liquid wastes containing dissolved or suspended copper compounds there is neutralisation, precipitation, flocculation, settlement, filtration, washing, drying, crystallisation, electrolytic, membrane processes, ion exchange and absorbents for removing and isolating compounds. Immobilisation techniques may afford improved stability for the final residues. Choice depends on the exact nature of the waste and the circumstances. Note that attempting to precipitate copper hydroxide in the presence of ammonia will result in the formation of soluble cuprammonium species.

Y23. Zinc compounds may utilise a very wide range of relevant processes. These include separation processes such as sieving, air classification, ballistic separation, float and sink, size reduction, magnetic separation etc for slags, mixed scraps, shredded wastes and dry material generally. For liquid wastes containing dissolved or suspended zinc compounds, neutralisation, precipitation, flocculation, settlement, filtration, washing, drying, crystallisation, electrolytic, membrane processes, ion exchange and absorbents may all be used to remove and isolate compounds. Immobilisation techniques may afford improved stability for the final residues. Choice depends on the exact nature of the waste and the circumstances. Note that attempting to neutralise acidic zinc solutions with sodium hydroxide will, if excess alkali is used, cause precipitated zinc hydroxide to redissolve, thus preventing separation.

Y24. Arsenic and arsenic compounds are invariably toxic, so whatever species is eventually generated for final disposal, avoidance of environmental dispersion must be a critical consideration. Processes associated with the physical separation of arsenical materials may include size reduction, sieving, washing, filtration etc. Chemical processing may involve neutralisation, precipitation, settling, flocculation and filtration, with immobilisation techniques applied to residues for enhanced stability.

Y25. Selenium and selenium compounds are generally toxic, although trace levels can be important dietary components for some species. Avoidance of environmental dispersion is important in final disposal of residues. Processes associated with the physical separation of selenium materials may include size reduction, sieving, washing, filtration etc. Chemical methods may involve neutralisation, precipitation, settling flocculation and filtration, with immobilisation techniques applied to residues for enhanced stability.

Y26. Cadmium and cadmium compounds have enjoyed widespread use over the years and are widely dispersed in the environment. They are very toxic, the focus of much environmental concern, and their use in many applications is being phased out or drastically reduced. Many processes relevant to these Guidelines may have use in dealing with cadmium wastes. Processes include manual sorting, sieving, air classification, flotation and float and sink, chemical processing/precipitation, electrolytic deposition, ion exchange, settlement, filtration and membrane processes. Immobilisation techniques may afford improved stability for the final residues.

Y27. Antimony and antimony compounds are perhaps less commonly encountered, but do display toxic properties. Relevant processes can include precipitation, settlement and filtration, and possibly ion exchange and membrane processes. Residues may be subjected to immobilisation techniques for added stability.

Y28. Tellurium and tellurium compounds are not commonly encountered and are mostly considered to be of relatively low toxicity. Their chemistry has similarities to selenium (Y25) and some waste processing opportunities are accordingly similar.

Y29. Mercury and mercury compounds are invariably toxic and all are considered to be serious environmental polluters. The emphasis in disposal is therefore to contain and prevent dispersal into the wider environment. Many former applications for mercury and its compounds are now being phased out in an attempt to avoid the need for dealing with their wastes. Relevant processes include float and sink, settling, absorption, distillation, precipitation, filtration, ion exchange, membrane processes and immobilisation techniques.

Y30. Thallium and thallium compounds are toxic, but the metal and its compounds are not frequently encountered in waste management activities. Relevant processes include precipitation, settlement, flocculation and filtration as well as electrolysis, although immobilisation techniques may render residues more stable.

Y31. Lead and lead compounds are widely dispersed in the environment. Most are inorganic, but there are a few organometallics which pose rather different problems. Relevant processes for the inorganic and metal itself include manual sorting, sieving and screening, air classification, ballistic separation, flotation, magnetic separation, precipitation, settlement, flocculation and filtration. The organometallic compounds may be initially oxidised to produce an inorganic lead compound and an organic material.

Y32. Inorganic fluorine compounds (excluding calcium fluoride) are generally toxic on account of the fluorine, and may also be associated with a potentially toxic cation. Many inorganic fluorides are reasonably soluble in water. Membrane processes may be helpful in some cases for separating and concentrating the fluorine species, but final disposal options relevant to these Guidelines are likely to involve precipitation as calcium fluoride and/or use of immobilisation techniques.

Y33. Inorganic cyanides arise principally as solids from heat treatment or as solutions/liquids from electroplating and surface treatment. Solid material will need to be dissolved for subsequent treatment, this involving processes such as size reduction and dissolution. The cyanide itself can be readily oxidised, followed by neutralisation, settlement/flocculation and filtration. Electrolytic systems can also break down cyanide. Attention must also be given to the metals associated with the cyanide, as in plating activities these may include environmentally sensitive materials such as cadmium, nickel, copper and zinc - all of which must be dealt with by the process.

Y34. Acidic solutions or acids in solid form will require neutralisation. Solid material will usually first need to be dissolved and may benefit from size reduction to aid dissolution speed. Neutralisation may in itself bring metals from solution, but precipitation may be required as well. Settlement, flocculation/ sedimentation and filtration are also likely to be required.

Y35. Basic solutions or bases in solid form will require neutralisation. Solid material will usually first need to be dissolved and may benefit from size reduction to aid dissolution speed.

Neutralisation may in itself bring metals from solution, but precipitation may be required as well. Settlement, flocculation/ sedimentation and filtration are also likely to be required.

Y36. Asbestos (dust and fibres) are dealt with by relatively few relevant processes. Environmentally sound waste management principles dictate that asbestos wastes should be collected and bagged separately, and not allowed to become mixed with other wastes. If they are nevertheless mixed, separation is not easy and process choice must avoid proliferation and release of dust/fibres - wet methods may be preferred. Final disposal requires containment and prevention of wider environmental dispersal. Immobilisation techniques may have application from amongst processes covered by these Guidelines.

Y37. Organic phosphorus compounds usually hydrolyse on contact with water, the further breakdown of hydrolysis products sometimes assisted by oxidation. Organophosphorus compounds may absorb onto suitable substances and be separated and concentrated by membrane processes, by distillation and by solvent extraction. Extraction from substrates such as soil may be carried out by leaching or washing. Biological processes may be effective in some cases.

Y38. Organic cyanides often hydrolyse in contact with water, the further breakdown of hydrolysis products sometimes assisted by oxidation. Organic cyanides may absorb onto suitable absorbents, and may be separated and concentrated from waste streams by membrane processes, by distillation and by solvent extraction. Extraction from substrates such as soil may be carried out by leaching or washing. Biological processes may be effective in some cases.

Y39. Phenols and phenol compounds including chlorophenols may be separated and concentrated from waste streams by membrane processes, by absorption and possibly by distillation. Extraction from substrates such as soil may be carried out by leaching, solvent extraction or washing. Phenols may break down if subjected to strong oxidising agents and chlorine atoms can be stripped from chlorophenol molecules by chemical dechlorination. Some phenols are destroyed by biological processes, but chlorinated species are not usually efficiently broken down.

Y40. A number of processes are applicable to the disposal of ethers, mainly in connection with separating and/or concentrating them from other substances. These include distillation, evaporation and absorption, along with membrane processes. Some biological processes will breakdown ethers.

Y41. Halogenated organic solvents can utilise several of the processes in these Guidelines, particularly for separation, extraction and concentration of the solvent from other waste material. Relevant processes include distillation, evaporation, solvent extraction, absorption, stripping, washing/leaching, flotation and membrane processes. Destruction of halogenated solvents by processes relevant to these Guidelines is confined to chemical dechlorination and (to a very limited extent), biological methods.

Y42. Organic solvents, excluding halogenated solvents, employ much the same processes for separation, extraction and concentration as halogenated species (see Y41). Final disposal of nonhalogenated organic solvents by processes relevant to these Guidelines is principally confined to biological methods.

Y43. Congeners of polychlorinated dibenzo-p-furan may require extraction, separation and concentration from the larger volume of waste. This may be achieved by solvent extraction, washing, leaching, absorption and possibly membrane processes. Destruction of the dibenzofurans by processes relevant to these Guidelines is confined to chemical dechlorination and possibly biological methods. Small caches of concentrated dibenzofuran waste may sometimes be considered for encapsulation.

Y44. Congeners of polychlorinated dibenzo-p-dioxin: see Y43 above.

Y45. Organohalogen compounds other then those specifically referred to in Y39, Y41, Y42, Y43 and Y44 would include halogenated plastics, rubbers and resins, halogenated oils and greases, possibly refrigerants as covered by one of the Annexes to the Montreal Protocol and possibly also PCBs etc - although these have already been addressed in Y10. Relevant processes may include separation processes using sieving, air classification, flotation and float and sink, solvent extraction, washing, leaching, absorption, distillation and evaporation. Destruction of the chlorinated species within the scope of the processes covered by these Guidelines is limited to chemical dechlorination and possibly biological methods.

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