INTERNATIONAL PROTOCOLS ON WASTE CHARACTERIZATION AND LIFE CYCLE ANALYSIS FOR 3R INITIATIVES

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Introduction

- Product flow to different parts of the world and
- what are the constraints and solutions to the waste generated?
- Let us look at some of these constraints:
- Responsibility of the producer ends at the point of leaving the factory
- Under the 3R programme, the burden of waste materials to be taken by the producer i.e ‘e-wastes’. Is it practical to send all of the wastes back to the producer?
- When organic materials are concerned, the available literature indicate that under anaerobic digestion $100m^3$ gas/ton of wastes can be produced.

Cont. Introduction

- This scientific information can be used effectively, but it would be best if it was given in terms of dry weight.
- All of us use bulk density to describe the voluminous or denseness of waste materials.
- But if we could provide values for apparent and real (actual) densities more information could be obtained for an effective 3R Programme.
- One of the local companies, envisages to recycle LDPE, HDPE, PVC mixed with sand to produce a roofing tile- British technology.
- Waste could be imported from China, because India is taking some of our non-degradable materials.
    - Should we or should we not!

Objectives

In view of 3R activities;

- To formulate defined protocols on waste characterization and life cycle analysis
- To conduct waste characterization studies and provide the life cycle analysis of wastes and it's subsequent products.
- To develop and conduct training programmes on these studies for improving accuracy and dependency of data and information.

Formulation and Development of Protocols

- Considering waste composition studies

Waste Material	percentage
Bio Food	59.30
Bio Yard	18.23
Fine Paper	0.90
OCC (Old Corrugated Card Board)	2.00
OBB (Old Box Board)	1.20
ONP (Old News Papers)	1.41
PP Film	0.30
LDPE Film	1.10
HDPE films	1.90
PET Bottles (Polyethylene Terephthalate)	0.40
Nylon Bags	0.40
Tubes	0.30
Aseptic containers	0.10
Brown Glass Bottles	0.20
Clear Glass Bottles	0.70
Green Glass Bottles	0.30
Tin Cans	0.40
ABC's (Aluminium Beverage Cans)	0.02
Other Metal	0.20
Residual	10.62
Total	100.00

Type of waste	MC %	VS% db	Ash%db	TS% wb	VS % wb	Ash % wb
Glass 1	0.11	0.00	100.00	99.89	0.00	99.89
Glass 2	0.11	0.00	100.00	99.89	0.00	99.89
wood 1	42.93	82.09	17.91	57.07	46.85	10.22
wood 2	45.93	78.94	21.06	54.07	42.68	11.39
fiber 1	66.40	55.71	44.29	33.60	18.72	14.88
fiber 2	75.95	68.47	31.53	24.05	16.47	7.58
coconut shell 1	23.82	93.51	6.49	76.18	71.24	4.94
coconut shell 2	24.49	93.18	6.82	75.51	70.35	5.15
metal	0.83	0.00	100.00	99.17	0.00	99.17
plastic 1	6.59	80.77	19.23	93.41	75.45	17.96
plastic 2	2.56	80.41	19.59	97.44	78.35	19.09
polythene 1	40.38	94.19	5.81	59.62	56.15	3.46
polythene 2	60.04	84.82	15.18	39.96	33.89	6.07
paper 1	56.65	83.33	16.67	43.35	36.12	7.22
paper 2	52.87	86.38	13.62	47.13	40.71	6.42
Biodegradable1	65.21	66.67	33.33	34.79	23.19	11.60
Biodegradable2	65.90	65.66	34.34	34.10	22.39	11.71
MSW 1(Glass 7.14g)	53.05	40.64	59.36	46.95	19.08	27.87
MSW 2	67.43	69.65	30.35	32.57	22.68	9.88
MSW (without glass)	64.48	65.28	-65.28	35.52	23.19	12.33

Energy contents

- There are number of equations to determine the energy value of wastes
- LCVwet (kcal/kg) = $10^{(3.4643YW + 0.001736 Fd + 0.005781 Pls - 0.007268 M)}$, Universiti Putra Malaysia
  - Where FD is food waste, Pls is plastics and Yw is yard waste and M is moisture.
  - The model showed that the lower calorific value of RDF is positively correlated with the independent variables.
- $E = 81C + 342(H-O/8)+22.5S -6(9H+W)$
  - Dulong equation

Cont. Energy content

- The accuracy, moisture content etc are not specified in obtaining the energy content

- Further research studies should be undertaken to obtain actual energy values rather than relay on models.

- Since there seems to be biochemical energy not accoutered in determining the CV

Life cycle analysis

- Very few countries are focusing on this aspect of the study
- The influence of energy and life cycle should be rated or indexed
- The example of importing waste polythene from China, should depend on the energy used in transporting the wastes to Sri Lanka.
- One solution;
  - Let the market forces to decide
  - Or else incentives provided by the waste generating country of origin.
- These incentives could be based on the index worked out on the life cycle of the waste that originated

Cont. life cycle analysis

- In the case of making tiles out of waste polythene and sand
  - Energy required for the process should be accounted
  - Energy reductions in the traditional process of tile making should then be considered
- Furthermore reductions in the clay pits along river basins
- Sand mining from river basins may be a worse scenario.
- Instead make up sand or C&D wastes could be more appropriate.

Cont. life cycle analysis

- A very familiar example of so called waste reductions;
- By doing away with polythene packaging in fruit and vegetable industry.
  - Deterioration of F&V may be higher without the packaging
  - Higher quantities of wastes generated
  - Higher organic loadings on landfills
  - Higher transportation, thus higher energy losses

Cont. life cycle analysis

- However, anaerobic digesters could be used to generate power from the waste of F&V.
- How can one determine which of the reductions is better?
- Thus indexes are needed and made available for a judicial solution or an absolute one.
- Such examples are many and there could be health related issues.
- Indexing of health related issues may be beyond the scope and environmental economist are needed to provide a comparative value, through risk assessment.

Cont. life cycle analysis

- The sludge, similar to composted materials after anaerobic digestion could support cultivation, fixing carbon.
- This is then another dimension!
- The polythene used for packaging could be used for tile making or generate power
- Another dimension!
- Which is better? Can we give an answer

Cont. life cycle analysis

- If an answer is need, a scientifically defendable working methodology is needed
- Indexing thus require the following aspects to be considered;
- Waste characteristics to enable accurate mass balancing.
- Determination of calorific value precisely
- Life cycle analysis, considering type of wastes, energy balances and continued use – procreative

Training and R&D in 3R

- Can all of the countries provide accurate results?
- Most of us require training and R&D facilities to develop the required information.
- Each of the countries have specific types of wastes, which includes agriculture wastes
- An inventory on hazardous wastes is difficult to obtain
- Only through education and training programmes, accountability can be ingrained

Conclusion

- There should be protocols developed to have uniformity in characterizing wastes
- It is necessary to have a better method to determine energy value of wastes, including mixed wastes
- Indices should be found and consideration given to all aspects influencing the life cycle of products and wastes.
- An emphasis should be placed on training and R&D efforts in the above issues to promote 3R activities.

THANK YOU