

Experiences with circularity of Construction and Demolition (C&D) Waste Management

Dr N B Mazumdar
Chairman, International Academy of
Environmental Sanitation and Public Health
New Delhi 110078

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Structure of this presentation

- Expectations regarding environment, climate change and sustainability
- Promote 3R and Circular Economy for construction and demolition (C&D) waste management
- Business opportunities in C&D waste management
- The issues and opportunities may be country and region specific but it may be easier to illustrate using one country
- Lessons from the first commercial C&D waste processing plant in India
- Added business opportunities – combine with legacy waste management
- Regulatory aspects and standards
- Technical aspects of C&D waste management
- Technical aspects of legacy waste management
- Wrap up to bring in circularity for overall benefits to our dear planet

Circular Economy towards Net Zero Pathway for Waste Management: Recycling and Resource Recovery

- The world is becoming more and more competitive, particularly, with respect to availability of and access to natural resources (material as well as energy) and infrastructure necessary for our survival and our wellbeing.
- These aspects have become essential for the long term sustenance of our planet
- Recycling and resource recovery are key to building up a circular economy
- Only way to reduce use of fresh natural resources and wasting land by way of ever increasing landfills / dumpsites
- At the same time leading to reduced energy use
- We need innovation and smart waste management solutions to cope with ever changing situation
- **Here we will discuss about two opportunities which are interrelated – C&D waste management and legacy waste management**

What are the drivers for C&D Waste Management?

- Need for appropriate waste management
- C&D waste spoils other waste materials if stored and collected together
- Processing of MSW mixed with C&D waste is technically more complex, more space and more time is required
- Thus the value of other municipal solid waste reduces
- Even processing of mixed C&D is more challenging – technically and financially
- Appropriate recycling of C&D waste leads to saving of natural resources and land, which have long-term implications
- Proper management of C&D waste is hugely beneficial for the environment
- Air quality, water pollution and land pollution – all are impacted positively

Promote 3R and Circular Economy for construction and demolition (C&D) waste management

- Reduce, reuse and recycle – fits quite well with management of C&D waste.
- Reduction of C&D waste is possible through proper management of demolition activity as well as construction activity.
- In the ‘C&D Waste Management Rule’ of 2016, a very important dimension called ‘**De-construction**’ has been incorporated. This means preparing for planned selective demolition of a structure in which salvage, re-use and recycling is maximized.
- De-construction is the most effective when it is planned along with construction plan.
- Segregation of C&D waste at the point of generation into four streams has also been included in the Rule – (a) concrete, (b) soil, (c) steel, wood and plastics and (d) bricks and mortar.
- Large projects are encouraged to process at the site so that transport can be minimized. Certain exemptions are allowed if 80% material is recycled and re-used in-situ and requisite buffer zone is provided.

Sustenance of 3R and Circularity for C&D Waste Management

- **Comprehensive planning** crucial for success.
- Consideration of **Life Cycle Assessment (LCA)** and **Life Cycle Cost (LCA)** are essential for achieving sustainability aimed at smoothly going past the concession agreement period (usually 15-25 years).
- Projects are awarded through **competitive bidding**. Hence the persons preparing the bid documents must have complete understanding of the subject and have hands-on experience. The concerned Departments should have the collective grip on the subject and the ground situation.
- The required **land for the project**, especially for setting up a processing facility, should be identified, verified for suitability through EIA and be under complete control under the tendering Authority.

C&D waste management during disaster: a crucial topic

- Disaster preparedness is crucial.
- This is especially relevant for hilly areas, places near sea, earthquake prone areas (category 4 and above) and flood plains having history of flooding.
- Disaster may happen in both urban and rural areas but the extent and intensity are different.
- Each city should map availability of services (transport of medium to large quantities of mixed demolition waste), equipment to remove / unlock / cut or break large chunks of concrete or other structural material, nearest processing facility for C&D waste.
- Such facilities may not have adequate space to store the additional material. Hence storage areas for such situations should be identified to avoid confusion and delay.

Business opportunities in C&D waste management – Indian scenario

- Apart from the significant secondary benefits of better Municipal Solid Waste Management (MSWM) and continuous saving of land there is **prospect of revenue accrual**.
- Different types of recycled products can be produced such as, **GSB** for road work, **paving blocks** and **tiles, blocks** (substitute of bricks) and **manufactured sand**.
- This is still not practiced in majority of the municipalities although the **C&D Waste Management Rules, 2016** has been notified and the **IS 383 code** has been modified to accommodate utilisation of processed C&D waste.
- **At the same time, medium to large plants have been actually set up from 2009 having capacities of 150-2000 TPD.**
- While planning for setting up C&D waste management plant, the waste should be analysed, quantity measured for about a year and the market for recycled products surveyed. Then the system for storage, collection and processing plant should be planned / designed.

C&D waste generation in 10 cities (2015) GIZ and DA

Sl. No.	City	Daily generation (MTPD)*	Annual generation (MTPA)
1	Delhi	4600	1.38
2	Mumbai	2500	0.75
3	Chennai	2500	0.75
4	Kolkata	1600	0.48
5	Bengaluru	875	0.26
6	Ahmedabad	700	0.21
7	Patna	250	0.08
8	Jaipur	200	0.06
9	Coimbatore	92	0.03
10	Bhopal	50	0.02

*MTPD – million tons per day

Utilisation of Recycled Produce of Construction and Demolition Waste, BMTPC 2018 – 100 million tons per year

Standards: boost for business opportunities

- **Modification of IS 383: 2016 has significantly expanded the scope of this business**
- Manufactured fine aggregate (Manufactured sand):
 - Iron slag aggregate
 - Steel slag aggregate
 - Copper slag aggregate
 - Recycled concrete aggregate
 - Bottom ash from Thermal Power Plant
- Manufactured from other than natural source:
 - Iron slag aggregate
 - Steel slag aggregate
 - Recycled concrete aggregate
 - Recycled aggregates
- **Note: Iron slag aggregates already used by CSIR-CRRI in border roads**

IS 383: 2016 – Extent of utilization for different aggregates and fines

Type of aggregate	Maximum utilization permitted %		
	Plain concrete	Reinforced concrete	Lean concrete (less than M15 grade)
Coarse aggregate			
Iron slag aggregate	50	25	100
Steel slag aggregate	25	Nil	100
Recycled concrete aggregate (RCA)	25	20 (up to M 25 grade)	100
Recycled aggregate (RA)	Nil	Nil	100
Bottom ash from thermal power plants	Nil	Nil	25
Fine aggregate			
Iron slag aggregate	50	25	100
Steel slag aggregate	25	Nil	100
Copper slag aggregate	40	35	50
Recycled concrete aggregate	25	20 (up to M 25 grade)	100

The first commercial plant in India for processing C&D waste

- **The first plant was set up in 2009 at Burari area in Delhi in a 7 acre plot allotted by the Municipal Corporation of Delhi – initially as a pilot followed by commercial plant.**
- The concessionaire IL&FS Environmental Infrastructure & Services Ltd (IEISL) developed the facility completely indigenously through rigorous R&D work between 2009-2014.
- **This included development of technology – first ‘dry’ process followed by ‘wet’ process followed by product development and marketing efforts.**
- Initially 500 TPD plant was installed along with development of storage, collection and transport mechanism. Later capacity was increased to 2000 TPD.
- **The effort led the Government to formulate an elaborate set of C&D Waste Management Rules in 2016, separate from the Solid Waste Management Rules.**
- **Marketing was helped by BIS by amendment of IS 383: 2016**, which also included industrial waste slag from Iron, Steel and Copper plants and bottom ash from thermal power plants.
- Subsequently another processing plant of 500 TPD was installed at Shastri Park, Delhi.

C&D waste processing plant – dry process at Burari, Delhi



C&D waste processing plant (wet process) at Burari in Delhi



Wet processing plant (left) coarse aggregate (middle) and sand (right)



Value added products from processed C&D waste



C&D Management Processing Facilities in India

Sl. No.	City	Location	Processing capacity MTPD
1	Delhi	Burari	2000
		Shastri Park	500
		Mundka	150
2	Noida	Sector 80	150
3	Gurugram	Basai	300
4	Ghaziabad	Ghaziabad	150
5	Thane	Daighar	300
6	Indore	Devguradia	100
7	Hyderabad	Jeetimedla	300
8	Bengaluru	Chikkajala	1000
		Kannur	750
9	Ahmedabad	Gyaspur Pirana	1000
10	Tirupati	Tukivakam village	150
11	Vijayawada	Vijayawada	200
12	Chandigarh	Industrial Area phase I	150
13	Surat	Surat	300

Business opportunities in combination with legacy waste management

- Urban agglomerations have one or more dumpsites (unscientific landfill) for disposal of municipal solid waste.
- **Both C&D waste as well as legacy waste occupy significant land area without any productive use**

Basically, there are two options:

- To cover the dumpsite scientifically after planning all the aspects including post care.
- To recover the land blocked by the dumped waste material (also known as '**bio-mining**').
- The 2nd option gives rise to a new area developed by CSIR-CRRI (Central Road Research Institute).

Scope in legacy waste management

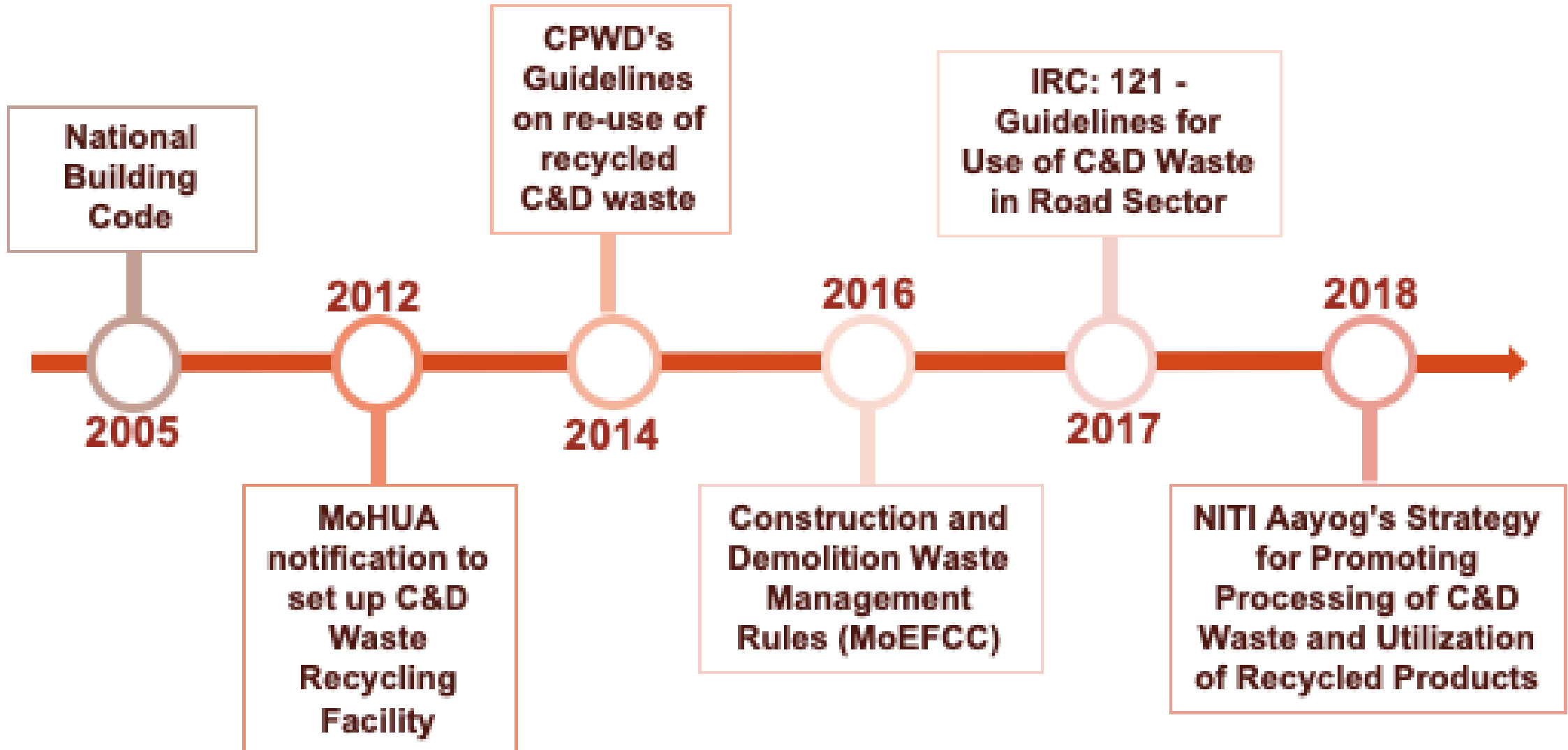
- CSIR-CRRI has done very innovative work with processed legacy waste from old municipal solid waste dumpsites in Delhi
- **Their R&D work and innovative laboratory studies concluded that 65-70% of the landfill waste (Legacy waste) can be suitably used in road embankment construction.**
- They carried out the required geotechnical tests (grain size analysis, Standard Proctor Compaction Test, Direct Shear Tests, Consolidation Tests Permeability Tests etc.)
- The segregated legacy waste was tested for presence of heavy metals like Zinc, Cadmium, Lead, Mercury, Cobalt, Chromium etc. which were found to be within limits prescribed by the Solid Waste Management Rules, 2016

Scope in legacy waste management

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- A code has been developed by the Indian Roads Congress (IRC:SP: 132 - 2022)
- **This material has the potential to be used as road embankment material for different categories of roads** (from rural roads to national highways).
- The segregated MSW material shall be <75mm as specified by MoRTH (Ministry of Road Transport and Highways) as requirement for conventional soil (***IRC:SP: 132 – 2022 “Guidelines on use of Industrial Wastes for Road Embankment and Subgrade Construction”, Indian Roads Congress***)

Timeline of regulatory steps and guidelines



Policy and Regulatory Issues

- Different types of waste are generated – particularly in urban areas, but their management is inter-related
- Hence the Government of India had notified 6 rules in 2016:
 1. Solid Waste Management Rules, 2016
 - 2. Construction and Demolition Waste Management Rules, 2016**
 3. Bio-Medical Waste Management Rules, 2016
 4. Plastic Waste Management Rules, 2016
 5. E-Waste Waste Management Rules, 2016
 6. Hazardous and other Waste (Management and Transboundary Movement) Rules, 2016
 7. Batteries (Management and Handling) Rules 2001, Amended in 2010 was also notified

Relevant Guidelines and Reports from the Government of India and other organizations

To assist implementation of the rules, the Government of India has published elaborate Guidelines from to time, some important ones relating to C&D waste management are:

- Municipal Solid Waste Management Manual (3 parts), Ministry of Urban Development, 2016 (contains section on C&D waste management)
- Resource Efficiency in the Indian Construction Sector: Market Evaluation of the Use of Secondary Raw Materials from Construction and Demolition Waste, GIZ and DA, New Delhi (2015).
- Construction and Demolition Waste. New Delhi, GIZ.
- Recycling, use and management of C&D wastes, ICI Bulletin 01 (Report of Technical Committee), Indian Concrete Institute, October 2015.
- Guidelines for use of construction and demolition waste in road sector, IRC: 121-2017, Indian Road Congress, 2017.

Relevant Guidelines and Reports from the Government of India and other organizations ..

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- Utilisation of produce of Construction and Demolition Waste: a Ready Reckoner, BMTPC (Building Materials & Technology Promotion Council), 2018, Min. of Housing and Urban Affairs, Gol.
- **Utilisation of Municipal Solid Waste in Road Embankment, CSRI-CRRI (Central Road Research Institute), sponsored by NHAI, 2016.**
- **Guidelines on use of Industrial Wastes for Road Embankment and Subgrade Construction,**
IRC:SP: 132 – 2022, Indian Roads Congress.

Examples of Government support

Delhi Advisory on use of recycled material

- Delhi PWD issued an advisory to all Delhi Government Departments in 2015, mandating 2- 10% use of recycled C&D waste products in building construction and road works.
- Was reissued by the Delhi PWD in 2018 - the updated advisory mandates use of C&D waste products and also advises that more small capacity C&D waste recycling plants, i.e., 500 TPD, should be installed at different locations in the city, including at least one for each major stakeholder of the government.
- The advisory notes that North Delhi Municipal Corporation has made available seven dumping locations for C&D waste generated from individual houses.

Alignment with Govt programs

- **Swachh Bharat Mission:** Flagship programme of Government of India for improving waste management and resource recovery; C&D waste management is squarely within its objectives. Cities must demonstrate improvements in cleanliness and waste management in comprehensive annual surveys, which should serve as an incentive to municipal bodies.
- **AMRUT:** Mission for urban infrastructure improvement with emphasis on pedestrian zones in 500 ULBs. Recycled products made from C&D waste (e.g., paver blocks) can be used beneficially for pedestrian zones.
- **Smart Cities Mission:** Mission envisions transformative projects in cities with an emphasis on innovation. C&D waste processing as well as utilisation of recycled products can be included in such projects.
- **Housing for All (Pradhan Mantri Awas Yojana):** Ambitious mission to address severe housing shortages by constructing 1.2 crores affordable housing units by 2022. Incorporation of “sustainable green materials” is encouraged by the mission, and recycled products from C&D waste will definitely find utilisation.

Technical aspects of C& D waste management

- The success of any C&D waste management plan depends on the following factors:
 - Appropriate storage of C&D waste (small, medium and large scale)
 - Collection and transport to the designated processing facility
 - Processing
 - Processing at the site of generation is also a good option for large generation in which case track / wheel mounted equipment can be used. Such arrangements can be moved as the work area shifts location.**
- Broadly the following steps are undertaken for dry process:
 - Size reduction (different types of crushers are available such as, cone crusher, vertical shaft impact crusher etc.)
 - Screening as required (grizzly to screens of different sizes as required)
- For 'wet' process:
 - Size reduction followed by washing and scrubbing
 - Removal of water using thickener and filter press
 - Recycling of water so that 10-15% make up water is able to satisfactorily run the process

Technical aspects of C& D waste management

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- Appropriate planning is crucial for success
- As of now suitable equipment of different types and sizes are available in the market as shown in the illustrations in the following slides.
- As mentioned in slide no. 5, last bullet, a thorough study of the ground situation (qualitative plus quantitative) round the year (variation due to season and festivals) should be carried out. Market (item, expected quality, pricing) should be surveyed.
- One important aspect in this business is the variation in quantity of waste generated on day to day basis.
- The facility should be planned accordingly with adequate buffer capacity.
- **In areas where industrial slags are generated (indicated in amended IS 383), the business can be planned for both (C&D waste and industrial slag).**
- In this case the technical aspects need to be planned carefully along with inventory and storage of different products.

Wrap up

- Appropriate management of C&D waste and legacy waste can open up good business potential.
- Processing / recycling of these materials would save certain resources and free up the land used for dumping and in the process bring in a lot of business opportunities.
- Large housing projects and infrastructure (roads, bridges, airports, ports etc.) projects generate huge quantity of C&D waste.
- Industrial plants for iron, steel, copper, thermal power etc. which generate large quantities of slag / bottom ash provide additional business potential.
- Processing of legacy waste for material for road embankment can provide an effective tool for decimating our old dumpsites.
- The above opportunities can provide effective private public partnership opportunities.
- The techno-financial aspects and the environmental issues need to be worked out for sustainability.

Thank You

Dr N B Mazumdar

Email: nbmazumdar@gmail.com

nb.mazumdar@iaesph.org