Management of Municipal Solid Waste in China - Mechanical Biological Treatment can be an Option?

The Sino-German RRU-BMW Research Project to apply BMWM within the Framework of Waste Management related Policies.

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Abstract

Biological Treatment of urban solid waste has a history of about 20 years in China, but due to low technology standards and polluted feedstock resources the output material compost was not accepted by the users. The Chinese MSW contains twice biodegradable organic matter as in Europe. Some cities in China, such as Beijing, Shanghai, Guangzhou are re-considering the treatment of organic wastes in parallel to the limited sucessfull operated incineration plants and land fills. Beijing, hosting the 2008 Summer Olympic Games, will spent at least 630 million RMB from 2004 – 2008 to invest in waste treatment throughout its suburbs. The Sino - German Cooperation project on 'Resource Recovery and Utilisation of BMW', RRU-BMW, supported by the Liaoning Provincial Department of Science and Technology and implemented in Shenyang/Liaoning Province, will investigate the attitude of the population towards source separation of bioorganic waste, develop design criteria to employ appropriate MBT technologies and provide advise how to integrate BMWM into the existing waste management practice.

Keywords

Mechanical- biological treatment of municipal solid waste, bioorganic municipal waste, biogas, renewable energy, sustainable waste management in China, opinion research

1 Introduction

In China 146 million metric tons of Municipal Solid Waste were collected from about 26 % of the population in 660 cities in 2003. The tendency is clearly increasing due to progressing urbanisation, modernisation of life and consumption behaviour, extension of waste collection logistics.

Supporting national policies on 'Renewable Energy' (20 % of electricity to be derived from renewable energy sources in 2020) and 'Circular Economy' may foster the production and CHP utilisation of biogas from anaerobic digestion of bioorganic wastes and the production of 'clean' compost.

The ongoing project on 'Resource Recovery and Utilisation of BMW', RRU-BMW a Sino - German Cooperation project supported by the Liaoning Provincial Department of Science and Technology, carried out in Shenyang/Liaoning Province, will develop the design criteria to employ appropriate MBT technologies. The project will first of all provide information about the attitude and behaviour of the population towards source separation of BMW, indicate the benefits of different collection systems. Field- and lab-test data will provide information about quantities, qualities, composition, biodegradation behaviour, and pollution of biogas and compost.

The aim of the CIM/GTZ project activities in China are further to attract German and European technology providers as well as potential investors and joint venture partners to approach the upcoming possibilities in participating in the Chinese Waste Management market.

2 Status of Municipal Solid Waste Treatment in China

2.1 Waste Treatment

In China in 2003 there are 574 solid waste treatment plants and engineered disposal sites operated. These facilities have a total capacity of 73 million t/a (219,000 t/d) corresponding to a treatment rate of 49.7 % m/m of total waste collected. The structure of waste disposal and treatment facilities is shown in Table 1 and the development of waste collection and waste treatment is displayed in Figure 1. It is estimated that these figures are representing only about 40 % of the MSW produced all over China.

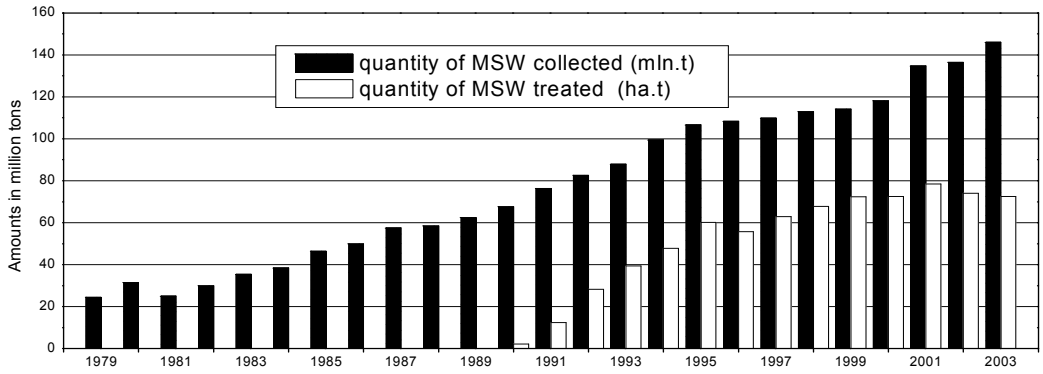


Figure 1 MSW collection and controlled disposal in China, 1979 to 2003 [1]. Sammlung und Behandlung/Deponierung kommunaler Siedlungsabfaelle in China, 1979 - 2003.

Even the overall policy aims MSW treatment to replace gradually dumping sites the MSW treatment level is considerably low and since 2000 the number of treatment plants and the capacities are decreasing (see Figure 1). The reasons are that new facilities are replacing old ones and the old sites are closed down due to insufficient equipment or just because landfills volumes are exhausted and sometimes the new capacities cannot be put in operation in time. Treatment sites, which do not comply with the 'standard', are not recorded. Therefore more than 50 % of the MSW is dumped at landfills without leachate- and landfillgas collection and treatment or processed at composting plants causing odour and leachate pollution and which do not produce compost for utilisation.

Table 1 Structure of Solid Waste Treatment Capacities in China (2003) [1]. Abfallbehandlung-sanlagen in China in 2003.

Type of treatment	Number	Capacity [million t/a]	Capacity [%]
Landfill	457	63.8	88
Incineration	70	5.8	6.9
Composting	47	3.7	5.1
Total	**574**	**73.3**	**100**

2.2 Landfills

The recent trend is to equip the new landfills with high-density PE lining. 4.5 million m^2 of baseline systems were built in 2004. The collection and treatment of landfill gas to reduce environmental pollution and to contribute to the reduction of greenhouse gas emissions and to generate power was a priority issue. In 2004 the following landfill gas power plants were built:

Table 2 Landfillgasinstallations in China 2004.
Projekte der Deponiegaserfassung mit Deponiegasverwertung in China 2004.

Landfill site	Capacity [kW $_{el}$]	Investment [mio RMB]	Commends
Beijing - Beishenshu	1 x 500		1st phase
Xi'an - Jiangcungou	2 x 1,250		1st phase, Australian support
Wuhan - Erfeishan	2 x 600	23	Dutch support, new landfill
Guangzhou - Xingfeng	2 x 970		50.000kW/h_{el}.d, in 2010 10 MW_{el}
Wuxi - Taohuashan	2 x 960	20	China, 1,300 m^3 LG/h
Beijing - Anding			2nd approved China CDM project (800,000 t CO_2 within 10 years reduced), NL support (currently 6 CDM projects approved, incl. 3 LFG projects)

2.3 Incineration

Although the bioorganic (and therefore water content) of MSW of China is high (twice compared to MSW from Europe) and the heat value is low (about 3,500 kJ/kg), with development of economy, waste incineration treatment is highly desired in many areas of China. In 2004, more than 5 domestic waste incineration plants (3,900 t/d) have been built and started operation (see Table 3). In addition 9 incineration plants with a total capacity of 6,500 t/d (Guangzhou, Amoy, Jinjiang, Wenzhou, Huizhou, Kunshan, Puyang, Shijiazhuang, Suzhou) are expected to be operational in 2005. It is expected that MSW incineration treatment will be developed significantly within the next 10 years.

Table 3 Incineration plants newly operational in China, 2004.
Inbetriebnahme von Muellverbrennungsanlagen in China 2004.

Incineration Sites	Capacity [t/d]	Investment [mio RMB]	Remarks
Shenzhen - Longgang	675	286	Start-up 01/2005, Grate furnace,1stphase
Tianjin - Shuanggang	1,200	568	Start-up12/2004 Grate furnace
Hangzhou - Binjiang	450		Start-up 08/2004 Grate furnace
Wuxi	1,000		Start-up 07/2004,1st phase
Yancheng - Yandu	600		Fluidised bed

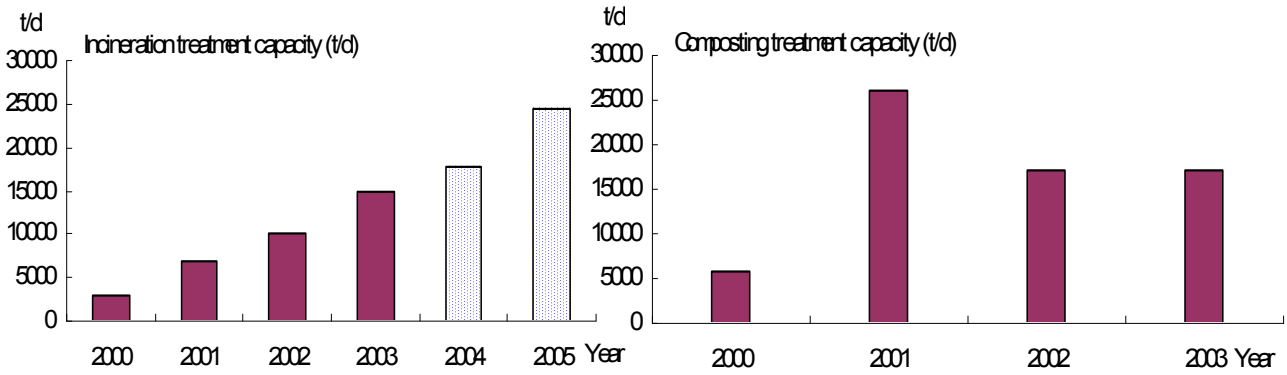


Figure 2 Capacities of Incineration Plants, 2000 – 2005, Capacities of Biological Treatment Plants in China, 2000 – 2005/2003.
Kapazitaeten von Muellverbrennungsanlagen und Biotechnologischen Abfallbehandlungsanlagen in China, 2000 – 2005/2003.

2.4 MSW Composting

MSW composting has a long history in China but the sucess stories are still missing. One reason is that MSW in China is still mixed collected. Wrong process understanding and low compost quality (in terms of impurities and plant tolerance) results in bad marketing. In 2004 some biological waste treatment projects were shown on media as bad investment examples (Hefei of Anhui; Yuncheng-Shanxi; Sichuan: none of 8 composting plants out of 11, built by using public funds in Sichuan run normally). MSW composting is currently experiencing stagnation (see MSW Composting Treatment

Table 4 Biological Treatment Plants in China, capacities and costs (Shenyang project is proposed). Kapazitaeten und Kosten Biologische Abfallbehandlungsanlagen in China (das Project in Shenyang wurde auf Bais RRU-BMW empfohlen).

Project/Site	Type of Plant	Cap. t/d	Invst mio RMB	Treat. Fee RMB/t	Invst RMB/ 1000t	Commends
Guangzhou	MSW AD	1,000	320		320	planned (no 2nd AD step)
Shenyang	*BMW AD&Com*	*200*	*60*		*300*	*biogas revenues 2 mio RMB/a*
Hohhot	MSW Comp.	600	150	50	250	(simple technology)
Hefei Anhui	MSW	400	100		250	2004, US, no operation
Shanghai Pud	MSW Comp.	1,000	230	80	230	2002, (Backhus technology)
Daqing	MSW Comp.	800	162		202	2000, (Backhus technology)
Fushun	MSW Comp.	800	154	30	192	2002, (Backhus techn.)
Yuncheng	MSW Comp.		7			not operating

Project/Site	Type of Plant	Cap. t/d	Invst mio RMB	Treat. Fee RMB/t	Invst RMB/ 1000t	Commends
Heng Guangxi	BMW Comp	20	1.7		85	aerated platform, roofed
Shanghai	MSW AD	650		140		planned, Valorga/Linde
Beijing Nango.	MSW Comp.	400	200		500	2002, Noel Tunnelcomp, KFW
Beijing	Food W. AD	270				planned, Valorga/Linde
Tianjin	Var. Wastes, Comp.	250	0.5*	50 (80)		BMFT, open pile system (120 RMB/t) * process control

Capacity from 2000 to 2003, see Figure 2). The official opinion is theoretically, kitchen biowaste could be sorted for composting treatment through pre-sorting. However, this method on one hand increased operation costs and on the other hand, it is difficult to ensure quality of compost products. The RRU-BMW project wants to investigate the possibilities to collect BMW by public participation in the households.

2.5 BMW Treatment

Besides of two pilot projects, one in Heng county Guangxi (7,000 t/a) and the RRU-BMW project in Shenyang no efforts were made in China to far to introduce separation of BMW from remaining wastes (and packing material, which are merchandised by every household themselves anyway) at the source. The BMW composting plant in Heng County can be seen as a successful project where high quality compost is used by the farmers and the treatment is done to reasonable costs in a mainly rural environment. The low structure content and low ligninocellulosis content of the BMW collected in municipal areas required a better anaerobic treatment in the first step, before the dehydrated digestat is converted into clean compost in a second step.

3 Sino – German RRU-BMW Project

3.1 Objectives

The Sino-German cooperation research project on 'Resource Recovery and Utilisation of Bioorganic Municipal Waste – RRU-BMW' in Shenyang is supported by the German partners University of Weimar, Schaefer Company and Brendebach Consultants, by the Austrian RAB, by the Liaoning Science & Research Programme and Liaoning Environmental Protection Volunteer Association (Green Liaoning). The project (main phase

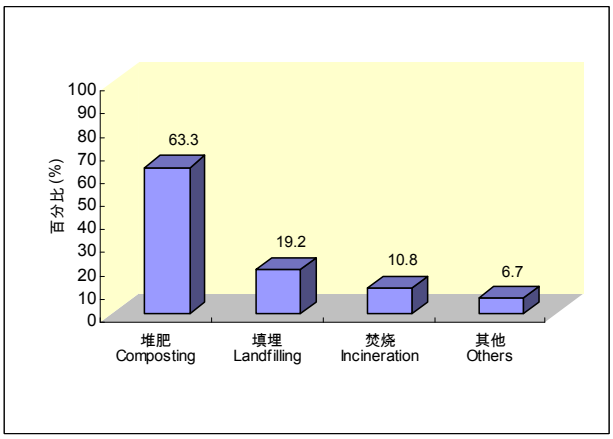
from March 2005 to March 2006), aims to assess the possibilities to apply the approach of biotechnological processing of source separated BMW within a sustainable Chinese integrated waste management concept. The main objectives are to investigate:

- BMW collection in 4 pilot areas in 2 Shenyang districts (app. 750 people)
- BMW quantities and qualities generated by 2 different ways of collection (PSS, SSS)
- composition of MSW and RMW (standard waste sorting analysis)
- biodegradability and compost quality (laboratory & field composting)
- BMW specific gas yield and gas quality by operating a AD laboratory scale fermenter
- and develop an appropriate communication strategy to achieve public participation
- opinion and attitude of the citizens towards source separation of BMW
- recommendations for an appropriate BMW management system and treatment technology
- economic and financial implications

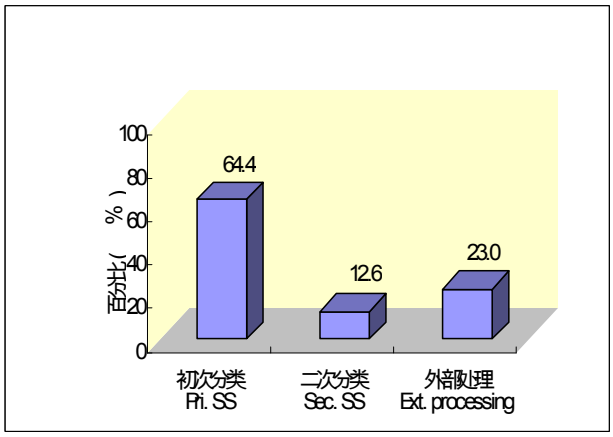
3.2 Communication Strategy and Opinion Research

In order to communicate the project idea to the participants in the pilot areas and the decision makers from the authorities a communication strategy was tailored. Within this package of public relations activities an assessment of the public opinion about the main project related question was carried out. In total 730 project participants in the pilot areas and interviewees from the general public had been given a questionnaire prior to the project activities, or prior the project activities were published. Therefore 86 % of the participants are willing to participate actively in source separation activities and only 2.5% say ‘no’ (Q7). ‘Primary source separation’ is seen to be useful by 64.4 %, ‘Secondary source separation’ by community workers is preferred by 13 % and 23 % think that a technical waste sorting plant can be employed (Q8). 28 % have the judgment that the low recycling rates in Shenyang are as of lacking the facilities (waste bins,) and 30 % believe the awareness of the population is too low. As most relevant supporting tools 40 % see the establishment of an appropriate waste bin system and 40% see general governmental support as required. 18 % of the participants in the pilot areas want the government to implement more supporting policies but the enforcement of a compulsory system combined with possible penalties is only acceptable to 5 %.

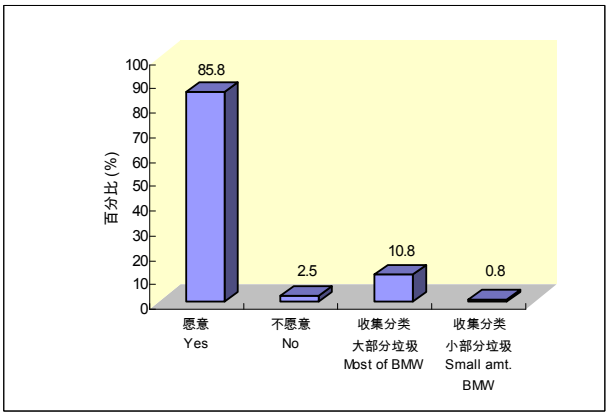
Q12: Preferred Route of MSW Treatment



Q8: Preferred BMW Collection



Q7: Willingness to Participate in BMW SS



Q11: Frequency of SS BMW Collection

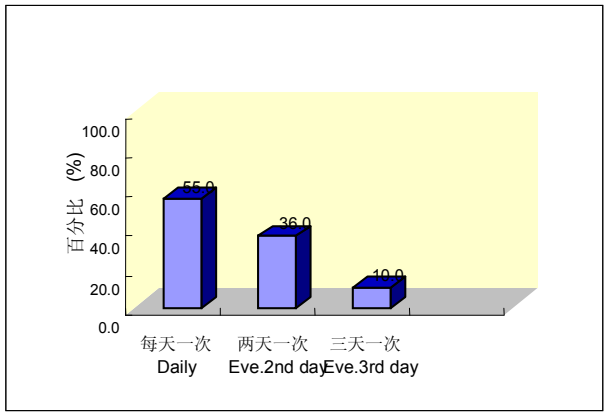


Figure 3 Public opinion research on biowaste resource recovery, source separation and treatments (results in %, based on 453 valid answers), 2004. Meinungsumfrage zur getrennten Erfassung biogener Abfaelle, Shenyang in Maerz - June 2004.

28% see it necessary to have the biowaste bin in the household, 13 % perceive it as appropriate to develop BMW source separation step by step according to the development of the conditions and 23 % would like to leave the beginning of these activities to public Institutions such as Universities and advanced residential areas (NIMBY syndrome = not in my backyard). 55 % of the target group want to have the source separated biowaste collection on a daily basis (as now MSW), 36 % agree to every 2nd day and only 10 % believe that every 3rd day is acceptable for emptying the waste bins (Q11). From all obtainable waste disposal techniques (landfilling 19 %, incineration 11 %, others techniques 7 %), Biowaste – treatment is for 63 % the favoured way of treatment (Q12). Main results are shown in Figure 3.

3.3 RRU-BMW Pilot Areas Shenyang

The pilot areas were selected jointly with 'Green Liaoning' NGO and the district EPBs and construction administrations, considering different social living standards, geographical areas in Shenyang (2 districts), and different approaches to separate the waste (PSS, SSS). The positive feedback from the participating households in Huanggu and Dongling district has motivated both the District Government as well as the management of other residential communities to request for an extension of the BMW source separation activities.

3.4 Bioorganic Municipal Waste (BMW)

3.4.1 Aerobic biodegradability (Composting)

The biodegradability of the collected BMW is analysed in the ICEEE laboratory. The laboratory scale 8x 18 lt. composting modules are to measure the aerobic biodegradability. The composters are equipped with controlled forced aeration, temperature and CO_2/O_2 monitoring, bio filter and leachate collection. The effect on biodegradation of the feedstock material (90 % m/m BMW and 10 % m/m grinded corn straw) is displayed as mass (FM) reduction after 3 weeks amounts to up to 50 %. The temperature course during composting reaches more than 65 ºC (hygienisation period) and can be reduced by air control to the preferred level of 57 ºC. The O_2 course and the pH Value during composting are recorded and used as process control parameter. The BMW collected shows a high ability for aerobic biodegradation. The main difficulty is the lack of structure and the increase of density during the microbiological degradation process. Composting requires therefore a high amount of structure material (more than 50 Vol. % corn or rice straw), which is a question of availability and costs. The application of an anaerobic treatment prior composting is recommended.

Table 5 RRU-BMW Waste 6 months collection data, total-, specific- and annual (projection) amounts of BMW, RMW and MSW collected in the 4 RRU-BMW pilot areas 3/9-2005. Sammelergebnisse für Biotonne, Restabfall und Mischabfall in den 4 Versuchs-Gebieten in Shenyang, März bis September 2005.

14-03 till 11-09-05	Persons in pilot areas	BMW			Non BMW	RMW		MSW	
(182 days)	[n]	[kg]	[kg/c.a]	[%m/m]	[%m/m] n=3	[kg]	[%m/m]	[kg]	[kg/c.a]
Primary Source Separation – PSS									
Beifang Yiyu	155	7,575	98		2	1,436		9,01	117
Van Ke	143	4,759	67		3.4	772		5,532	78
Quan Yuan	207	7,342	71		2.7	1,847		9,189	89
TOTAL PSS	505	19,676	**79**	***83***	2.7	4,055	***17***	23,731	**94**
Secondary Source Separation - SSS									
Dong You	180	6,574	73	*76*	1.6	2,098	*24*	8,672	97

3.4.2 Anaerobic biodegradability (anaerobic digestion)

The quantity of biogas, which is produced under anaerobic conditions from source separated BMW in the 4 RRU-BMW pilot areas, was investigated by applying a standardised and internationally proved methodology. The CH_4 content was measured by GC-MASS. The tests were conducted over a period of 50 days at 37 ºC.

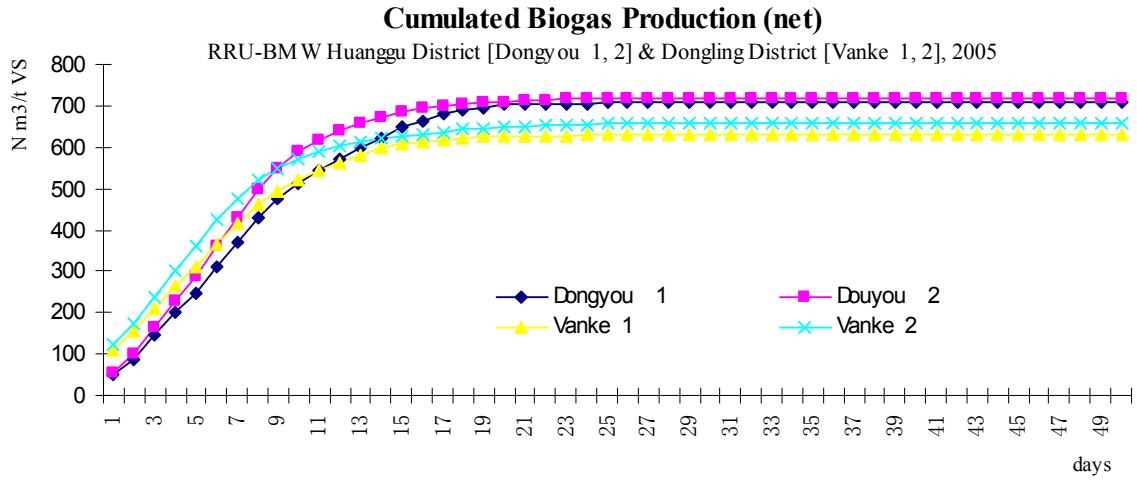


Figure 5 Course of cumulated net-biogas production during anaerobic digestion at 37 ºC during 50 days, from RRU-BMW (2005), ICEEE Laboratory. Gesamt Netto-Biogasproduktion aus Bioafall aus Versuchsgebieten in Shenyang 2005.

The course of biogas and CH_4 generation from pilot areas' PSS-BMW is shown in Figure 5. The net- biogas production ranges between 100 and 120 m^3 biogas per t of BMW feedstock, respectively the net-CH_4 production per ton of volatile solids (VS DM) was found to be in the average 455 Nm^3 (388 – 499), which is within the upper range of the anticipated amount of 200 – 500 Nm^3/t VS. For further investigations and to simulate a full scale BMW process a 4 x 30 l AD simulation lab equipment will be operated during the 2nd half of the project.

3.5 Residual Municipal Waste (RMW)

The quantity of RMW after PSS of BMW amounts to about 17 % m/m FM of total waste collected from the pilot households (see Figure 6).

Table 6 Lower calorific heat value (Hl = kJ/kg) of MSW and RMW (average 4 pilot areas, 4 samples, 4 analysis each) and average figures from EU (RDF after mechanical processing (SSS: secondary source separation, PSS: primary source separation). Heizwertanalysen von MSW und Restabfall aus der PSS und SSS, mit EU vergleichswerten.

Sample	MSW	RMW (SSS)	RMW (PSS)	MBT (RDF)
05 - 04 - 22	3,751 ± 10%	6,920 ± 10%	14,788 ± 8%	-
05 - 05 - 12	3,360 ± 37%	5,808 ± 26%	16,154 ± 22%	-
05 - 05 - 24	3,695 ± 23%	6,128 ± 22%	15,261 ± 12%	-
05 - 06 - 08	3,794 ± 6%	7,843 ± 41%	19,528 ± 17%	-
RRU-BMW average	**3,650 ± 20%**	**6,674 ± 29%**	**16,446 ± 18%**	-
EU average	**7,760**	*Not practiced*	**8,120**	**18 – 26,000**

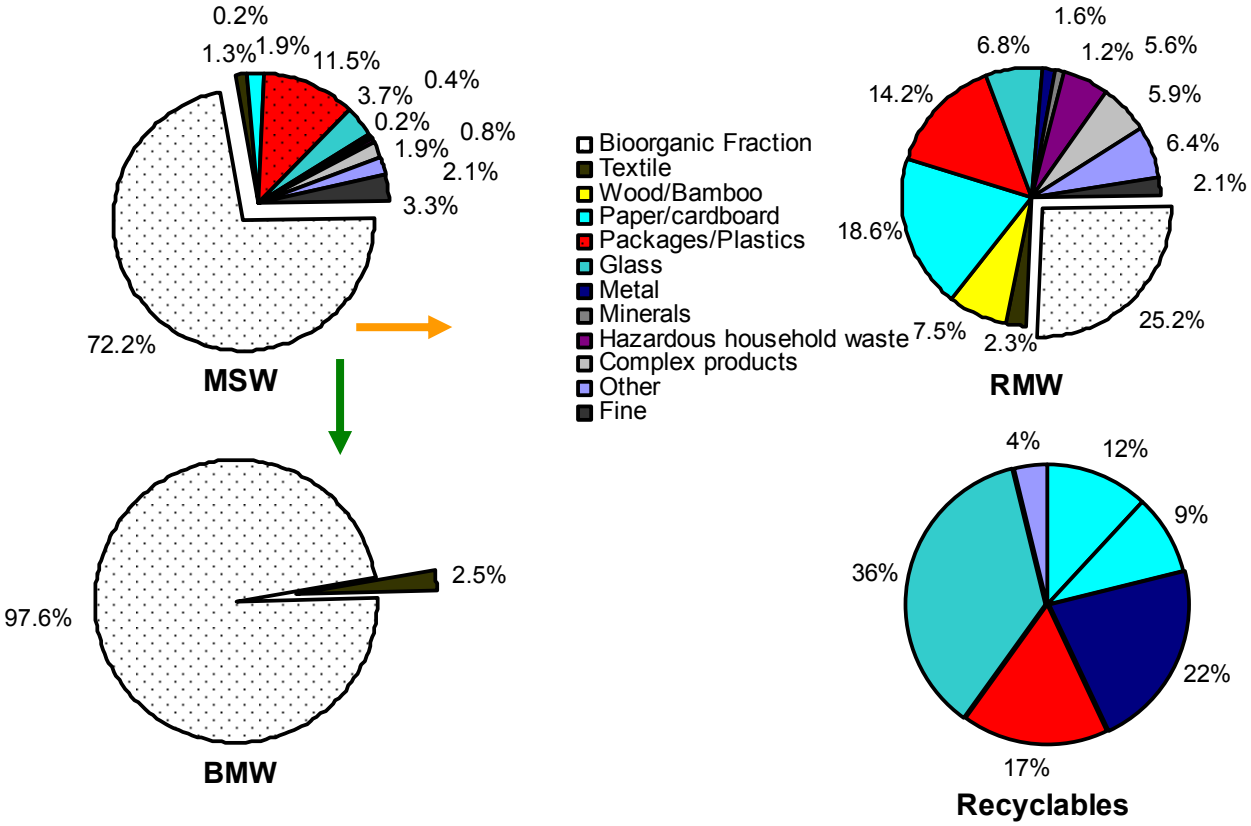


Figure 6 Composition of wastes from the RRU-BMW pilot areas in Shenyang, MSW is diversified into RMW, BMW and Recyclables by PSS (3-9/2005). Zusammensetzung verschiendener Abfallfraktionen aus den RRU-BMW Versuchsgebieten zur getrennten Sammlung (Bioabfall, Restabfall, Verpackungs-und Werstoffe)

Though RMW contains still about 25 % (20 – 50 %) of bioorganic matter (mainly paper tissues, organic kitchen waste) the calorific value of PSS-RMW has increased from 3,650 kJ/kg FM (MSW) to 16,600 kJ/kg and the thermal utilisation of this fractions as RDF can be anticipated (Table 6).

The quantity of BMW & RMW collected from the households is 95 kg/c.a. About 80 % of the Energy is contained in 17 % m/m RMW. Figure 6 shows the composition of MSW, RMW and Valuable Materials generated by the households in the pilot areas.

4 Shenyang Recommended Strategy to Reduce Landfilling

The total household waste (MSW) shown in Table 5 is based on the data from the 6 months investigations and the annual per capita amount is 95 kg (between 78 and 117 kg). These figures do not include packaging materials and other materials which are considered valuable and which are merchandised as secondary raw materials by the households themselves prior disposal. The total household waste generated by middle-income families is about 150 kg/c.a, from which the landfill only receives less than 120 kg. The difference to the 250 kg daily of MSW delivered to the landfills in SY (5,000 t/d) is the waste from non-household sources (commercial, institutional and outdoor activities, markets and road cleaning). The estimated distribution of total MSW fractions in Shenyang is shown in Figure 7. Currently 85 % of the MSW produced in Shenyang are disposed to landfills (250 kg/c.a), from which about half is coming from non-household sources. The recommended future system WM system should consider the material and energy utilisation of BMW and RMW, an increased recycling rate and the operation of a household hazardous waste collection system (batteries, paints, medicines, solvents, mineral oil) by the EPB. These measures will lead to a landfill rate of about 17 % without a significant change of costs.

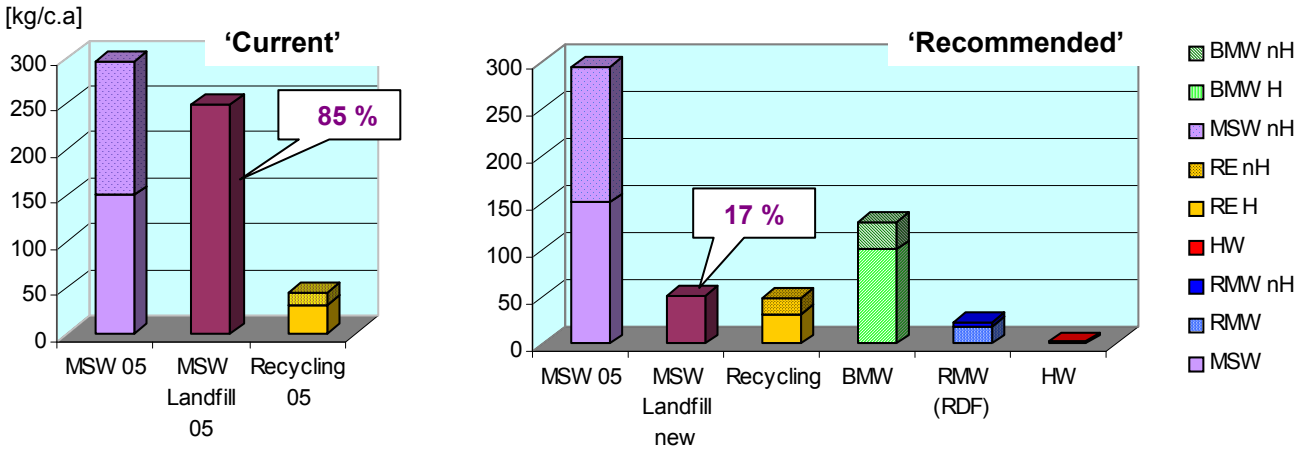


Figure 7 Estimated household (H) and non – household (nH) MSW quantities and routes of treatment and disposal in Shenyang, current and proposed system [kg/c.a]. Einschaetzung der gegenwaertigen hausmuellaehnlichen Abfaelle aus Haushalten und nicht-Haushalts Bereichen, derzeitige und kuenftig vorgeschlagene Entsorgung.

5 Summary

Various new policies set up to enhance sustainable development of China are linked to waste management and they will be supportive to speed up the development of a comprehensive waste management infrastructure in China. Those policies and treaties are mainly to introduce:

- Circular Economy
- Environmental Management of Enterprises (CP)
- Promotion of Renewable Energy (2005)
- Reduction of Greenhouse Gas emissions (Kyoto Protocol)
- Desertification prevention and soil protection
- Polluter Pays Principle/Introduction of public waste fees (2002)
- Public Participation
- International Exchange of Environmental know-how and technology
- Stockholm Convention (ban of POPs)
- Revitalisation of the North – East of China

Chinese MSW has a content of biodegradable organic matter at least twice compared to MSW from Middle-Europe. Therefore 'Bioorganic Municipal Waste Management' requires to be better promoted in China. The so far implemented biotechnological waste treatment projects are from limited success, due to poor technologies, poor performance of operating staff and maintenance, and due to the fact that a low quality endproduct from mixed waste treatment does not satisfy the enduser. The differences between MSW – (Co-) composting and 'Mechanical Biological Treatment' are not evident and the legal basis to phase out landfilling of organic wastes does not exist. But possibilities to introduce source separation of Organic Wastes are looking more promising as this strategy complies with recent policies and revenues from biogas (revenues 0.4 RMB/m^3) and clean compost can be expected (market price for high quality compost is up to 120 RMB/m^3). Therefore source separation of BMW is seen as an essential tool to further develop waste management practice in China. Public Participation can be achieved and will contribute to employ a more economic and sustainable waste management infrastructure. Composting of BMW could only be realised by applying high amounts of structure material. Anaerobic Digestion and the production of biogas (renewable energy) and of 'clean compost' are therefore recommended. The project has investigated a biogas production rate of 100 – 120 m^3 /t of BMW feedstock, ranging at the upper expected level.

Chinese Authorities are gradually going to source out Waste Management Service activities and to approach private investment and BOT partners. By introducing waste fees the conditions might get more reasonable (cost covering). It is expected that the China Solid Waste Service sector will reach about 1 % of the GDP (with an annual growth rate of 15 %) and will offer more employment opportunities. To achieve this goals China makes efforts to facilitate better the communication with the international society, and institutions such as the LN Technology Exchange Promotion Centre for North-East China have to be further developed to approach a better international cooperation in this field.

6 Zusammenfassung

In China werden zur Zeit zahlreiche umweltpolitische Maßnahmen umgesetzt die sich förderlich auf die Ertüchtigung einer nachhaltigen abfallwirtschaftlichen Infrastruktur des Landes auswirken wird. Im einzelnen handelt sich unter anderem um folgende:

- Einführung einer Kreislaufwirtschaft
- Umweltgerechte Unternehmensführung, einschließlich 'Cleaner Production'
- Ein Gesetz zur Förderung 'Erneuerbarer Energie' (2005)
- Beitrag zur 'Reduzierung der Klimawirksamen Gase' (Kyoto Protokoll)
- Bekämpfung der Bodenerosion (Bodenschutz)
- Einführung 'PPP' und öffentliche Abfallgebühren (seit 2002)
- Verstärkte Bürgerbeteiligung (über 'residential committees' und Massenmedien)
- Intensivierung internationale Zusammenarbeit im Bereich Umwelttechnologie
- Umsetzung der Stockholm Convention (ban of POPs)
- Nationales Programm zur Förderung der wirtschaftlichen und technologischen Entwicklung der Nord-Ost Regionen Chinas

Chinesischer Siedlungsabfall enthält doppelt so viel bioorganische Substanz als kommunaler Abfall in Mitteleuropa. Somit erscheint es sinnvoll die Bewirtschaftung Biogener Abfälle (BMWM) stärker zu fördern. Ein Problem stellt die Tatsache dar dass aufgrund schlechter Technologien, schlecht ausgebildeter Betreiber und sehr oft aufgrund fehlender Betriebskosten und in Ermangelung eines sinnvollen Absatzes qualitativ schlechte Endprodukte aus der Behandlung gemischter Abfälle, die Erfolge ausgeblieben sind. Die Bedeutung der biotechnologischen Vorbehandlung vor der Deponie und die sinnhaftigkeit der Mechanisch Biologischen Abfallbehandlung im Sinne der europäischen Gesetzgebung sind nicht relevant und eine Politik zur Reduzierung der Ablagerung organischer Abfälle ist nicht verankert.

Das Verständnis bezüglich der Möglichkeiten ‚biogene Abfälle' energetisch und/oder stofflich zu verwerten ist hingegen gegeben und an entsprechende Pilotvorhaben sind in Vorbereitung. Die getrennte Sammlung biogener Abfälle ist hingegen im absoluten Pilotstadium, wobei die Begründung in der Tatsache zu finden ist dass bisherige Projekte zur getrennten Sammlung von Wertstoffen aus verschienen Gründen (starker informeller Sektor, keine Öffentlichkeitsarbeit,) nicht erfolgreich waren. Gutschriften für Biogaseinspeisung (0.4 RMB/m3) und der Absatz von ‚clean compost' (Erlöse bis zu 120 RMB/m3 sind möglich). Die Bereitschaft der Bevölkerung an sich an der getrennten Sammlung zu beteiligen wenn Aufklärungsarbeit geleistet wird und die Verwertung gesichert ist konnte durch das RRU-BMW Projekt verifiziert werden. Die Untersuchungen bestätigen das Mengenaufkommen, die biologische Abbaubarkeit (wobei infolge mangelnder Strukturmaterialanteile Kompostierung nicht zu empfehlen ist. Das Biogasbil-

dungspotential wurde im oberen Erwartungsbereich, und die ‚primary source separation' als die schadstoffärmste Methode der Bioabfallsammlung bestätigt.

Die Chinesischen Behörden haben inzwischen die Möglichkeit abfallwirtschaftliche Aktivitäten zu privatisieren und über 'BOT' Verträge auch internationale Investoren und Betreiber anzusprechen. Die stufenweise Einführung von Abfallgebühren sollten dazu beitragen den Sektor wirtschaftlich zu ertüchtigen. Der chinesische 'Solid Waste Service Sektor' sollte 1 % des GDPs (bei einer 15 %igen Wachstumsrate pro Jahr) erreichen and neue Arbeitsplätze bringen. Um diese Ziele In China zu erreichen bemüht sich China die Kommunikation mit den internationalen Partnern zu verbessern, wobei Institutionen wie das geplante ‚Liaoning – German Technology Exchange Promotion Centre' eine Plattform darstellt die Kommunikation zu foerdern.

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Abbreviations

AD	Anaerobic digestion (fermentation)
BG	Biogas
BOT	Built-Owned-Transferred
BMWM	Bioorganic Municipal Waste Management
CDM	Clean Development Mechanism (trade emission under the Kyoto protocol)
CIM	Center for International Migration and Development of the German Government, Frankfurt
ICEEE	Institute of Clean Energy and Environmental Engineering of SYIAE
MBT	Mechanical Biological Treatment
MSW	Municipal Solid Waste
RMW	Remaining/Residual Municipal Waste
RDF	Refuse derived fuel