Vlastimil Altmann, Pavel Neuberger

THE MUNICIPAL WASTE COLLECTION YIELD ASSESSMENT IN THE CZECH REPUBLIC'S REGIONS

Summary

The objective of this paper is to zoom in on the system of separated waste collection in Czech Republic (CR). The system of packing waste collection is described. The analysis of collection of base commodities of communal waste (paper, plastics and glass) in chosen regions has been carried out. Středočeský region has been chosen because of the number of its inhabitants and as well because of its location in the middle part of CR and because it neighbours with the Czech capital city, Prague. Region Vysočina shows average values in base commodities collection. The results of the chosen regions are being compared to the present status of separation of these wastes in CR which is counted by packing company EKO-KOM. The company caries out back withdrawal and usage of wastes of mentioned packages.

INTRODUCTION

After 1992 the Czech Republic has started to integrate itself more and more into processes organizing by the European community. There was a need in the field of wrapper waste to resolve its salvage and its re-using. EKO-KOM, an authorised packaging company, has started its activities in September 1997. Main objective of EKO-KOM is to guarantee salvage of wrappers which are produced in Czech cities. At this time is possible to litter the recyclable waste into special containers for a paper, plastic and drink packets. Gradually is possible to separate a biowaste, too. Generally is possible to claim that the waste is separated by 65% of Czech population and, for example, in collecting plastic waste the Czech Republic reaches the highest value in Europe in conversion to 1 inhabitant.

Company EKO-KOM ensures a system of integrated duty of salvage and re-using of wrapping waste through systems of separated collection in cities and

through activities of people who are allowed to treat with waste. EKO-KOM doesn't treat personally with the wrapper waste but it participates especially in financing expenses which are linked with salvage, collection, separation and recycling of wrapper waste. A scheme of the system is shown in Fig. 1. Contemporary position of the system and records of recycling is shown in Tables 1-3.

Source: http://www.ekokom.cz/scripts/detail.php?id=68
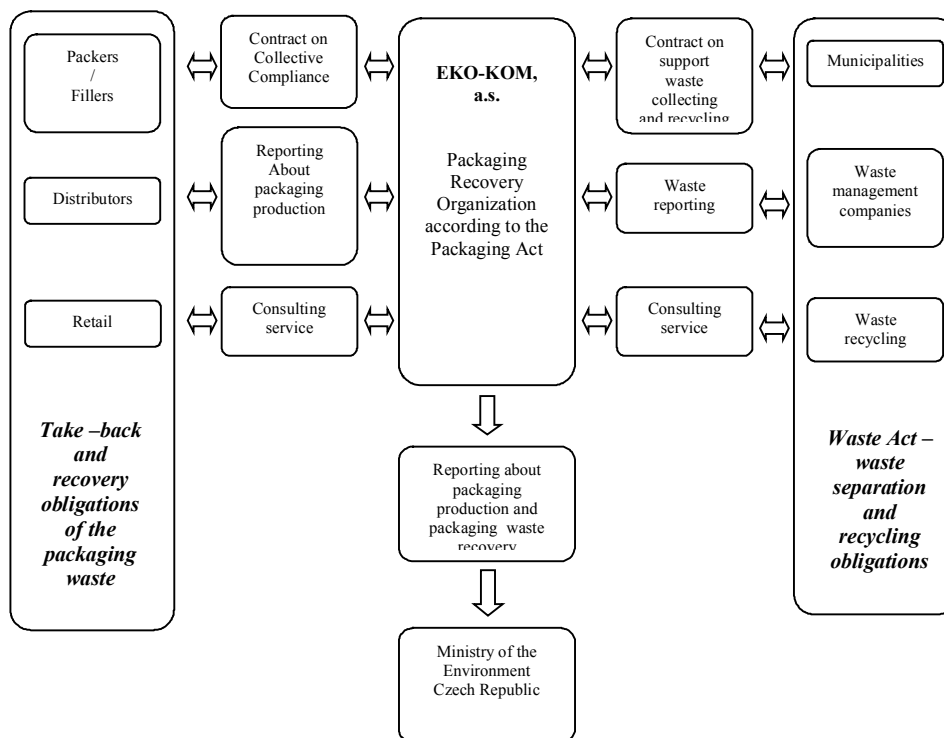
Figure 1. Scheme of the EKO-KOM system

Table 1. Numbers of clients and quantity of wrappings which are mentioned in EKO-KOM system

	2001	2002	2003	2004	2005	2006	2007
Number of clients	581	15,084	20,754	21,164	21,502	20,946	20,798
Casings introduced to the market in CR (t)	717,227	1,427,949	2,342,027	2,356,664	2,573,565	3,125,861	3,666,721
- empties non returnable	252,846 (35%)	489,698 (34%)	697,952 (30%)	725,706 (31%)	774,784 (30%)	831,199 (27%)	874,180 (24%)
- empties	464,381 (35%)	938,251 (35%)	1,662,075 (35%)	1,630,958 (35%)	1,798,781 (35%)	2,294,662 (35%)	2,792,541 (35%)
Packings market share	35.3%	57.6%	77.7%	78.4%	79.3%	80%	81%

Source: http://www.ekokom.cz/scripts/detail.php?id=95

In Table 1 you can see very fast growing quantity of wrappings placed on the Czech Republic's market and also growing percentage of recovery of packaging waste in total quantity.

Table 2 shows that since 2001 there is growing quantity of separated waste per inhabitant/year. Quantity grossed up in 6 years from value 18.7 kg to 48.7 kg, so it is on the average about 5 kg per year. In years 1999 and 2000, which are not mentioned in Table 2, there were shown values of 9.3 (or, more precisely, 12.4 kg) per inhabitant/year.

Table 2. Number of villages which are engaged in system EKO-KOM

	2001	2002	2003	2004	2005	2006	2007
Number of municipalities	581	15.084	20.754	21.164	21.502	20.946	20.798
Number of inhabitants	8,135,238	9,116,400	9,504,706	9,799,894	9,946,614	9,988,586	10,084,371
Share of population	79%	88%	93%	96%	97%	97%	98%
Utilized waste in total (t)	152,196	223,080	333,770	406,126	464,640	547,645	585,911
Recovery factor of separated waste in kg for inhabitant in year	18.7	24.4	28.4	33.9	36.2	43.6	48.7

Source: http://www.ekokom.cz/scripts/detail.php?id=95

Table 3. Percent of recycled waste of throw-away package in EKO-KOM system

The percentage of recycling	2002	2003	2004	2005	2006	2007
Paper	62	67	79	85	92	96
Glass	57	57	65	68	74	68
Plastics	27	34	38	42	46	52
PET in plastics	*33*	*34*	*40*	*49*	*52*	*60*
Metal	35	40	37	32	44	54
Total	45	49	56	60	66	68

Source: http://www.ekokom.cz/scripts/detail.php?id=95

MATERIAL AND METHODS

Interpretation of collection system and recovery of packaging waste is implemented in the chosen samples of villages in two regions: Central Bohemia

(Sč) and Bohemia´s Highlands (Vy). Villages are in each region divided according to the number of population into 4 groups:

1) Villages to the 499 inhabitants,
2) Villages from 500 till 1999 inhabitants,
3) Villages from 2000 till 10000 inhabitants,
4) Villages over 10000 inhabitants.

The mentioned villages were chosen on the basis of quantity of collected waste (kg/inhabitant/year) in its region. The first village in each table is always the best regarding to quantity of collected waste in mentioned region and by size group, too. Another 3 villages have average quantity of collected waste and the last village has lowest quantity of collected waste.

Analysis of collecting of separated waste generally involve 2 points of view:

a) Comparsion of chosen villages in the region of Central Bohemia and in Bohemia´s Highlands, which are divided into particular size categories according to the number of population,
b) Comparsion of both regions as a whole with the capital city Prague

Evaluation of villages is implemented by tables and graphically, too. In each table according to the number of population there are indications of whole region.

RESULTS AND DISCUSSION

Central Bohemia region is chosen for comparison of area's unit (one of the worst assessed region with an average 23,8 kg per inhabitant/year) and region Bohemia's Highlands, which is – in term of yield of separated waste – moderate region in Czech Republic. In terms of regions are villages divided according to the number of the population to 4 groups. Tables 5 to 8 show the quantity of separated waste from communal waste and on Figs. 2 to 5 is a graphic illustration of values from charts.

All values are re-counted to specific quantity, using unit **kg.inhabitant^{-1}.year^{-1}**. Average values in charts are always reach for whole region.

Table 4. Input dates of regions

	Region Central Bohemia	**Region Bohemia's Highlands**
Area	11 015 km² (14.0% ČR)	6 796 km² (8.6% ČR)
Number of inhabitants	1 175 254 inhabitants (11.4% ČR)	511 645 inhabitants (5.0% ČR)

Table 5. Quantity of separated waste in villages up to 499 inhabitants
(kg.inhabitant^{-1}.year^{-1})

Municipalities up to 499 inhabitants							
Region - Středočeský				**Region - Vysočina**			
Municipality / separates waste	**Paper**	**Glass**	**Plastic**	**Municipality / separates waste**	**Paper**	**Glass**	**Plastic**
Pavlov	21.49	79.31	29.31	Důl	25.16	41.18	16,45
Medonosy	24.70	35.37	20.13	Bělá	6.46	11.25	13,87
Nosálov	7.51	40.66	9.08	Kozlany	0.00	12.55	11,89
Sýkořice	0.00	23.93	19.45	Křeč	5.45	8.24	3,69
Mnichovice	0.00	6.34	3.07	Domamil	2.26	3.87	4,59
Average in a district	*5.15*	*11.14*	*7.87*	*Average in a district*	*5.07*	*13.35*	*7.22*
Total average	*24.16*			*Total average*	*25.64*		

Table 6. Quantity of collected waste in villages up to 1999 inhabitants
(kg.inhabitant^{-1}.year^{-1})

Municipalities up to 1 999 inhabitants							
Region - Středočeský				**Region - Vysočina**			
Separates waste Municipality	**Paper**	**Glass**	**Plastic**	**Separates waste Municipality**	**Paper**	**Glass**	**Plastic**
Klecany	23.93	11.01	13.62	Bohdalov	5.01	16.18	9.94
Lužná	17.14	6.82	5.65	Opatov	3.09	12.13	5.55
Čistá	11.94	7.24	6.36	Tasov	10.67	5.72	3.64
Bratronice	1.25	6.65	15.52	Dukovany	7.47	3.46	6.69
Nelahozeves	7.37	8.36	6.16	Oslavice	0.14	3.93	3.79
Average in a district	*6.97*	*9.25*	*8.11*	*Average in a district*	*6.51*	*10.15*	*6.65*
Total average	*24.33*			*Total average*	*23.31*		

Table 7. Quantity of collected waste in villages up to 10 000 inhabitants
(kg . inhabitant^{-1}. year^{-1})

Municipalities up to 10 000 inhabitants							
Region - Středočeský				Region - Vysočina			
Separates waste Municipality	Paper	Glass	Plastic	Separates waste Municipality	Paper	Glass	Plastic
Roztoky	25.30	13.33	13.17	Polná	22.99	13.04	10.46
Unhošť	9.21	4.57	11.90	Pacov	19.90	7.88	9.17
Hořovice	8.01	2.45	7.09	Přibyslav	16.00	10.86	9.98
Stochov	4.60	6.38	5.35	Žirovnice	13.34	8.05	5.14
Tuchlovice	0.41	2.23	3.24	Telč	3.86	9.07	3.71
Average in a district	*10.62*	*8.78*	*7.48*	*Average in a district*	*14.04*	*10.38*	*7.44*
Total average	*26.88*			*Total average*	*31.86*		

Table 8. Quantity of collected waste in villages over 10 000 inhabitants
(kg . inhabitant^{-1}. year^{-1})

| Municipalities over 10 000 inhabitants							
Region - Středočeský				Region - Vysočina			
Separates waste Municipality	Paper	Glass	Plastic	Separates waste Municipality	Paper	Glass	Plastic
Rakovník	13.41	8.99	6.23	Žďár nad Sázavou	32.59	9.10	7.34
Beroun	12.79	7.67	7.45	Nové Město na Moravě	16.73	14.35	7.04
Nymburk	12.85	7.42	5.30	Havlíčkův Brod	20.26	9.31	3.82
Kutná Hora	10.75	3.65	7.32	Velké Meziříčí	13.70	11.01	6.51
Kladno	11.87	4.72	4.61	Jihlava	19.61	7.48	4.00
Mělník	8.55	5.41	6.84	Pelhřimov	13.85	10.01	2.99
Příbram	7.94	4.28	2.75	Třebíč	13.95	7.76	3.61
Mladá Boleslav	5.70	3.12	4.76	Humpolec	13.00	756	3.68
Benešov	6.30	2.99	4.26				
Kolín	3.47	4.00	4.29				
Average in a district	*10.85*	*6.22*	*589*	*Average in a district*	*17.96*	*9.58*	*4.87*
Total average	*22.96*			*Total average*	*32.41*		
Praha	*18.83*	*8.42*	*6.87*				
Total average	*34.12*						
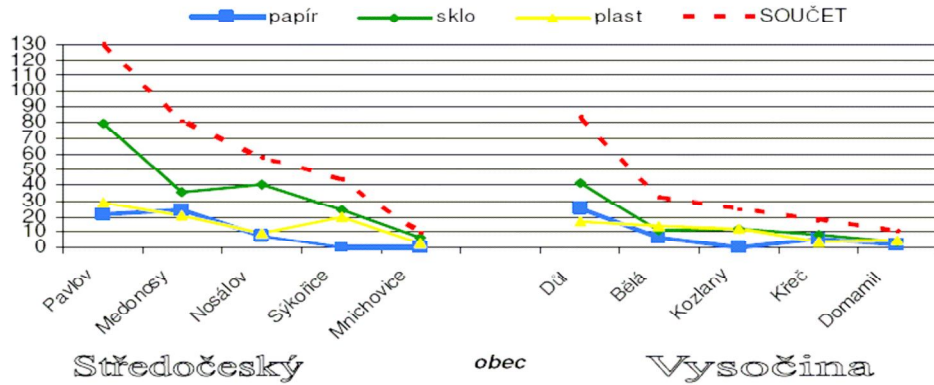
Figure 2. Graph of quantity of collected waste (kg **.** inhabitant[-1]**.** year[-1]) in villages up to 499 inhabitants
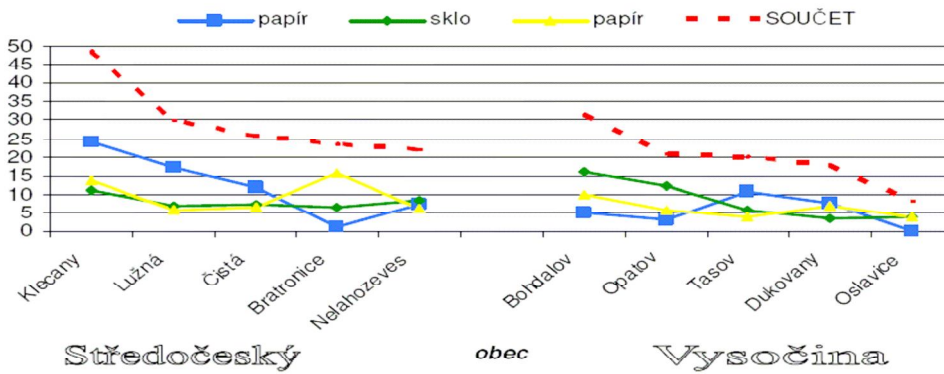

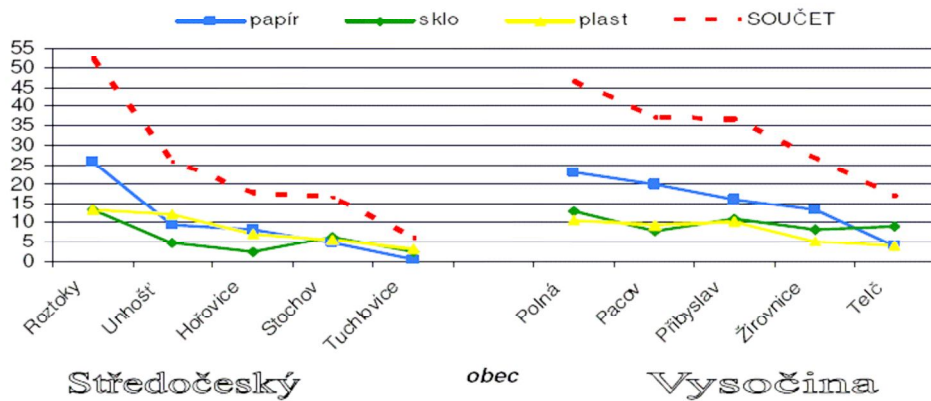**Figure 3.** Graph of quantity of collected waste (kg **.** inhabitant[-1]**.** year[-1]) in villages up to 1 999 inhabitants

Figure 4. Graph of quantity of collected waste (kg **.** inhabitant[-1]**.** year[-1]) in villages up to 10 000 inhabitants
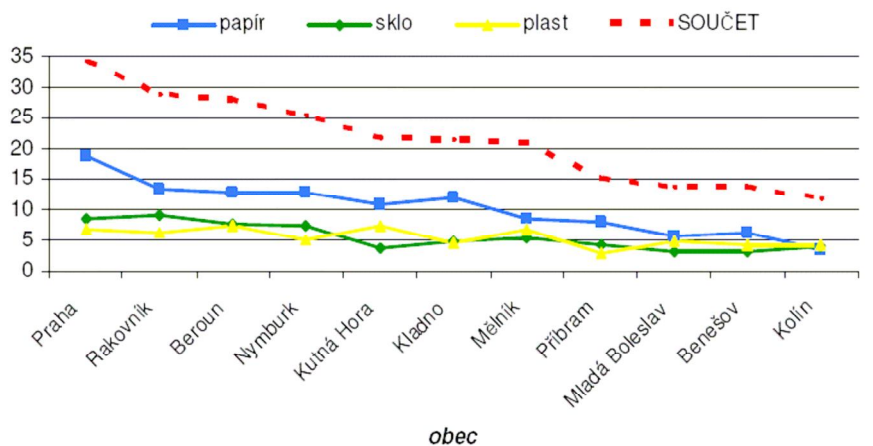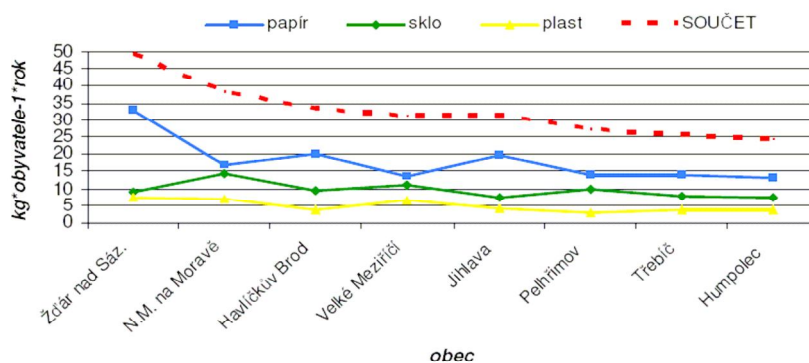
Figure 5a. Graph of quantity of collected waste (kg $\cdot$ inhabitant^{-1} $\cdot$ year^{-1}) in villages up to 10 000 inhabitants (Central Bohemia)

Obr. 19b: Graf srovnání obcí nad 10 000 obyvatel – Vysočina.

Figure 5b. Graph of quantity of collected waste (kg $\cdot$ inhabitant^{-1} $\cdot$ year^{-1}) in villages up to 10 000 inhabitants (Bohemia's Highlands)

VILLAGES UP TO 499 INHABITANTS

Looking on Table 5 and Fig. 2 you can see that the difference between region of Bohemia's Highlands and Central Bohemia is irrelevant. There is a major difference in yield of separated material only in case of glass commodity (Bohemia's Highlands). It is interesting that village Pavlov (Central Bohemia's region) has salvaged per inhabitant/year more than 130 kg (especially collection

of glass) which is about 50 kg more than one of the best collecting village in Bohemia's Highlands, the village Důl. There are some villages in this category in which are not separated all of three basic commodities: glass, paper and plastic. The glass is separated in all of chosen villages. This could be an effect of tradition. On the other hand a separation of plastic is a necessity in this time. Considering collection of paper – many families in villages heat up with solid fuel, so that paper is in most of these families used as a material for burning. It is obvious that separation of paper in this type of villages doesn't need to be economically profitable.

VILLAGES FROM 500 – 1 999 INHABITANTS

Differences in quantity of separated waste are irrelevant in this category (see Table 6 and Fig. 3). Villages are equipped with a gas rating, so that's why there is a difference compared to previous category - all villages collect all of basic commodities (paper, plastic, glass). There is interesting that two of villages in the same region which are both equipped with gas heating – have very different values of quantity of separated paper. In village Oslavice is separated circa 1% compared of quantity in village Tasov.

VILLAGES FROM 2 000 – 10 000 INHABITANTS

In this category you can see starting difference in total quantity of separated basic commodities (see Table 7 and Fig. 4). Generally is separated about circa 18% waste more and in case of paper 30% more in the Bohemia's Highlands than in Central Bohemia. This difference is caused by villages in Bohemia's Highlands, which are in separating of basic commodities more well-balanced (around a value of 35 kg per inhabitant per year). By contrast in Central Bohemia there are some villages with value of separating 40 kg, but much villages are mostly under the average limit.

VILLAGES OVER 10 000 INHABITANTS

In this case there are chosen provincial cities of Central Bohemia and all cities over 10 000 inhabitants from region Bohemia's Highlands. There is included Prague, too. Central Bohemia doesn't include Prague, but Prague has approximately same number of inhabitants as whole region Central Bohemia. In this comparison (Table 8 and Figs 5a, 5b) you can see the fact that Central Bohemia's city Rakovník shows the biggest quantity of separated waste (with value 28.63 kg per inhabitant per year). In Bohemia's Highlands has the highest value Žďár nad Sázavou (49.43 kg/inhabitant/year), which is about 72% more than

Rakovník. The difference between the lowest value of total quantity of separated waste (city Kolín- Central Bohemia and Humpolec – Bohemia's Highlands) is more than 206% (11.76 kg/inhabitant/year : 24.24 kg/inhabitant/year). Generally there is a difference in this category more than 41%.

Comparison of both regions is done also for Prague. Value of separated basic commodities is about 5% higher compared to Bohemia's Highlands and about 50% higher than in Central Bohemia. Rate between separated commodities in Prague and in Bohemia's Highlands is almost irrelevant.

CONCLUSION

Looking on given results and information is obvious that the highest quantity of separated basic commodities is produced in villages from 2 000 inhabitants and in bigger cities. Regarding total balance in Czech Republic there are evident big regional differences. It is possible to state that the best assessed city is Prague. There could be many reasons: complete information campaign how to separate waste inclusive periodic information in journals and press and also big number of places for paper, plastic and glass-containers all over the Prague. There are many offices equipped with bins for separate waste, too. Very important is work of all employees in the offices of each town district and also of all companies which collect the waste – they work in more competitive area compared with cities and villages in other regions.

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Vlastimil Altmann, Ing. Ph.D.,
Czech University of Life Sciences Prague
Faculty of Engineering
Kamýcká 129, Praha 6 – Suchdol
Czech Republic
e-mail - altv@tf.czu.cz,
tel. - ++420 224 383 144

Pavel Neuberger, Ing. Ph.D.
Czech University of Life Sciences Prague
Faculty of Engineering
Kamýcká 129, Praha 6 – Suchdol
Czech Republic
e-mail - neuberger@tf.czu.cz,
tel. - ++420 224 383 179

Reviewer: *Prof. Jerzy Gruszczyński, Ph. D., Dr. Sc.*