Table 6 PW LR analysis results

Model number	R^2	Description
1B	0.8871	Data set - not excluded municipalities
2B	0.9028	Data set without Sezemice
3B	0.9346	Data set without Litomyšl, Sezemice, Poličká
4B	0.9387	Data set without Litomyšl, Sezemice, Poličká, Přelouč
5B	0.9415	Data set without Litomyšl, Sezemice, Poličká, Přelouč, Seč
6B	0.9456	Data set without Litomyšl, Sezemice, Poličká, Přelouč, Seč, Lanškroun
7B	0.9468	Data set without Litomyšl, Sezemice, Poličká, Přelouč, Seč, Lanškroun, Živanice
8B	0.9484	Data set without Litomyšl, Sezemice, Poličká, Přelouč, Seč, Lanškroun, Srch
9B	0.9683	Data set without Chrudim, Litomyšl, Sezemice, Poličká, Přelouč, Seč, Lanškroun,
10B	0.9716	Data set without Chrudim, Litomyšl, Sezemice, Poličká, Přelouč, Seč, Lanškroun, Srch
11B	0.9750	Data set without Chrudim, Litomyšl, Sezemice, Poličká, Přelouč, Seč, Lanškroun, Srch, Svitavy
12B	0.9809	Data set without Chrudim, Poličká, Litomyšl, Sezemice, Přelouč, Lanškroun, Seč, Srch, Živanice, Staré Hradiště, Svitavy, Třemošnice

$$\hat{y}_{PW} = 4.0804 + 0.0068x, \quad (8)$$
$$\hat{y}_{PW} = 3.7922 + 0.0068x, \quad (9)$$
$$\hat{y}_{PW} = 3.3339 + 0.0067x, \quad (10)$$
$$\hat{y}_{PW} = 3.2125 + 0.0067x, \quad (11)$$
$$\hat{y}_{PW} = 3.0934 + 0.0067x, \quad (12)$$
$$\hat{y}_{PW} = 2.9759 + 0.0066x, \quad (13)$$
$$\hat{y}_{PW} = 2.8946 + 0.0066x, \quad (14)$$
$$\hat{y}_{PW} = 2.8569 + 0.0066x, \quad (15)$$
$$\hat{y}_{PW} = 2.8477 + 0.0065x, \quad (16)$$
$$\hat{y}_{PW} = 2.7276 + 0.0065x, \quad (17)$$
$$\hat{y}_{PW} = 2.6533 + 0.0064x, \quad (18)$$
$$\hat{y}_{PW} = 2.3855 + 0.0064x. \quad (19)$$

When modelling (similar as in the previous subchapter A) the municipality Seč was again excluded. This record shows high values of the selected waste types. This can be caused by the fact that this area is a highly touristy area, in particular in summer months. Containers are used here for waste that is collected separately (this knowledge is based on a query). However, we cannot also exclude the possibility of an error in entering the data to Pardubice Regional Office database

The best modelling result (model 12B) was obtained by excluding municipalities stated in Table 7. 12 municipalities were excluded. Nevertheless it could be possible that some further changes and amendments would bring about a higher value of R^2, however this change would be in the order of thousandth.

Table 7 Excluded municipalities for model

M_name	x	y_{PW} [t]	y_{PWI} [kg]
Litomyšl	9860	214.75820	21.78
Poličká	8915	168.01090	18.85
Přelouč	8665	124.47720	14.37
Sezemice	3493	153.70000	44.00
Třemošnice	3086	52.64338	17.06
Seč	1655	62.74760	37.91
Staré Hradiště	1491	56.91000	38.17
Srch	1331	59.59000	44.77
Žvanice	882	41.07000	46.56
Chrudim	22999	295.11600	12.832
Svitavy	17004	166.10520	9.769
Lanškroun	9637	130.13800	13.504

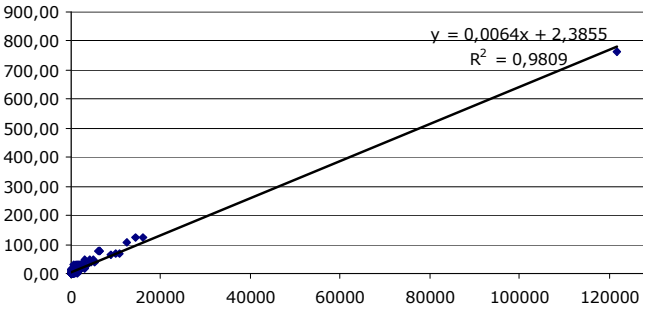

Fig. 4 Resulting LR line for $\hat{y}_{PW}$ (model 12 B)

Resulting regression equation for the estimation of the volume of variable $\hat{y}_{PW}$ in tons depending on the number of inhabitants x (Fig. 4) has the following form (19) and R^2 for this equation obtains value 0.98 which represents 98 % variability of the explained variable. As is the case with variable $\hat{y}_{MW}$ this is quite high value, thus this could be sufficient for practical utilization.

C. Prediction of GW volume

The dependent variable y_{GW} here is the total volume of glass in tons produced in the individual municipalities of Pardubice region in year 2010, the independent value is the number of inhabitants x.

The data matrix after removal of zero values included 407 municipalities. There were realized more that 20 models (dependent variable: amount of waste y_{GW} in tons, independent variable: number of inhabitants x). Based on the graphic illustration of data (Fig. 5) and the assessment of values of the variable y_{GWI} those records that could had been consider remote values were removed. Gradually the R^2 was increased. Exclusion of some objects from the data matrix did have hardly any influence on the value of R^2 (this concerned mainly municipalities with a low number of inhabitants and at the same time a high volume of produced glass per inhabitant). The number of excluded and further observed municipalities is stated in Tables 8 and 9.

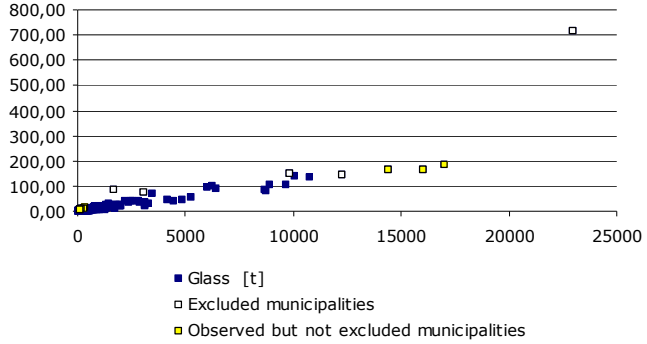

Fig. 5 Original data structure (excluded, observed but not excluded municipalities)

Note: Fig. 5 illustrates orientation location of the regression line, Statutory town Pardubice value is missing for better orientation reasons.

Table 8 Observed but not excluded municipalities

M_name	x	y_{GW} [t]	y_{GWI} [kg]
Svitavy	17004	182.39000	10.73
Ceská Trebová	16028	165.19430	10.31
Ustí nad Orlicí	14428	165.57900	11.48
Vrbatuv Kostelec	333	13.98800	42.01
Mladonovice	313	10.14900	32.42
Cenkovice	177	8.04000	45.42
Neratov	134	6.73700	50.28
Ceské Lhotice	102	5.94900	58.32

Table 9 Excluded municipalities for model

M_name	x	y_{GW} [t]	y_{GWI} [kg]
Chrudim	22999	714.73300	31.08
Vysoké Mýto	12292	143.60700	11.68
Litomyšl	9860	147.33000	14.94
Tremošnice	3086	74.33492	24.09
Sec	1655	86.26620	52.12

The value R^2 was observed under step by step elimination of selected municipalities. The most dramatic change against the model without exclusion of municipalities was recorded when municipality Chrudim was excluded (the difference is 0.1614) and after the exclusion of municipalities Chrudim and Seč (the difference against the model with excluded municipality Chrudim is 0.0043). With excluded municipalities Chrudim and Seč, Třemošnice, Vysoké Mýto a Litomyšl the highest value $R^2 = 0.9741$ was reached. Fig. 6 shows linear regression line for the resulting model. Selected modelling results are in Table 10.

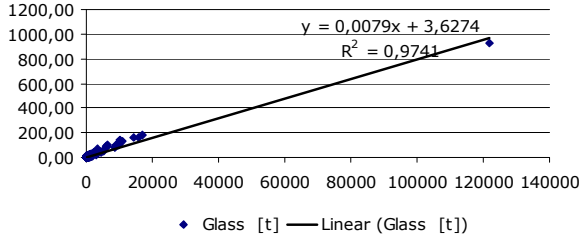

Fig. 6 Resulting LR line for $\hat{y}_{GW}$ (model 6C)

Linear regression equation (20) corresponds to model 1C, (21) model 2C , …, (25) the best model 6C and defines the predicted value of GW volume $\hat{y}_{GW}$ by the following way:

$$y\hat{y}_{GM} = 4.5012 + 0.0087x, \quad (20)$$
$$y_{GM} = 4.0925 + 0.008x, \quad (21)$$
$$y_{GM} = 3.9243 + 0.008x, \quad (22)$$
$$y_{GM} = 3.8173 + 0.008x, \quad (23)$$
$$y_{GM} = 3.7481 + 0.0079x, \quad (24)$$
$$y_{GM} = 3.6274 + 0.0079x. \quad (25)$$

Resulting regression equation for the estimation of the volume of variable $\hat{y}_{GW}$ in tons depending on the number of inhabitants x has the following form (25) and explains the 97.4 % of spread of the explained variable.

Table 10 GW LR analysis results

Model number	R^2	Description
1C	0.8016	Data set - not excluded municipalities
2C	0.963	Data set without Chrudim
3C	0.9673	Data set without Chrudim, Seč
4C	0.9692	Data set without Chrudim, Seč, Třemošnice
5C	0.9704	Data set without Chrudim, Seč, Třemošnice, Vysoké Mýto
6C	0.9741	Data set without Chrudim, Seč, Třemošnice, Vysoké Mýto, Litomyšl

D. Prediction of CW volume

In the Framework of the data set pre-processing in total 101 records with zero value were replaced. The fact that some municipalities show in this type of waste zero value is possibly caused by the fact that in some municipalities there are not paper and card board containers and there are no other collection spots where this waste could be deposited and later transported for further processing or liquidation. Despite this fact the modelling was done.

The used data matrix included in total 315 records. The dependent variable here was y_{CW} in tons for individual municipalities in year 2010, the independent variable here is x in individual municipalities of the Pardubice region. More than 40 models were executed with step by step elimination of the indicated municipalities (the exclusion was based on graphic illustration again and based on recalculated values of the variable y_{CWI}).

The highest R^2 increase was however observed with a model based on a file/data set where town Chrudim was not included ($R^2 = 0.7751$) that showed 36.94 [kg] of y_{CWI} and then the case where the statutory town Pardubice was excluded ($R^2 = 0.7639$) that on the other hand showed very small y_{CWI} (7.38 [kg]). With the exclusion of both municipalities we observed the decrease of the observed R^2 indicator against the previous two models ($R^2 = 0.7467$). After exclusion of Chrudim,

Lanškroun, Litomyšl, Letohrad, Žamberk and Svitavy, that showed quite high levels of variable y_{CWI} (model 8D) we observed an increase of the given indicator ($R^2 = 0.9034$) with regression equation (33) for the estimation of the volume of paper and card board $\hat{y}_{CM}$. When only Statutory town Pardubice was excluded, because of its different characteristics , and other municipalities were kept in the given data set (model 2D), the regression equation (27) was obtained for $\hat{y}_{CM}$.

Fig. 7 shows the basic structure of the data including excluded and observed but not excluded municipalities. The overview of excluded municipalities is in Table 11.

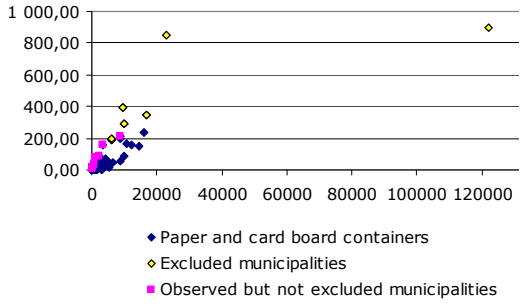

Fig. 7 Original data structure (excluded, observed but not excluded municipalities)

Table 11 Excluded municipalities for model

M_name	x	y_{CW} [t]	y_{CWI} [kg]
Letohrad	6228	189.81500	30.48
Žamberk	6043	198.56100	32.86
Pardubice	121854	899.52900	7.38
Chrudim	22999	849.51800	36.94
Svitavy	17004	348.13670	20.47
Litomyšl	9860	293.18730	29.74
Lanškroun	9637	395.77400	41.07

Table 12 shows the overview of the selected modelling results. Fig. 8 shows the graphic illustration of the model (8D).

Table 12 CW LR analysis results

Model number	R^2	Description
1D	0.6551	Data set - not excluded municipalities
2D	0.7639	Data set without Pardubice
3D	0.7751	Data set without Chrudim
4D	0.8244	Data set without Chrudim, Lanškroun
5D	0.8344	Data set without Chrudim, Lanškroun, Letohrad
6D	0.8603	Data set without Chrudim, Lanškroun, Letohrad, Litomyšl
7D	0.8746	Data set without Chrudim, Lanškroun, Letohrad, Litomyšl, Žamberk
8D	0.9034	Data set without Chrudim, Lanškroun, Letohrad, Litomyšl, Žamberk , Svitavy

Linear regression equation (26) corresponds to model 1D, (27) model 2D , …, (33) the best model 8D and defines the predicted value of CW volume $\hat{y}_{CW}$ by the following way:

$$\hat{y}_{CM} = 6.1848 + 0.0092x\,, \quad (26)$$
$$\hat{y}_{CM} = 8.8475 + 0.0225x\,, \quad (27)$$
$$\hat{y}_{CM} = 5.4381 + 0.0084x\,, \quad (28)$$
$$\hat{y}_{CM} = 4.6807 + 0.0082x\,, \quad (29)$$
$$\hat{y}_{CM} = 4.3092 + 0.0082x\,, \quad (30)$$
$$\hat{y}_{CM} = 3.7967 + 0.0080x\,, \quad (31)$$
$$\hat{y}_{CM} = 3.3855 + 0.0080x\,, \quad (32)$$
$$\hat{y}_{CM} = 2.9947 + 0.0078x\,. \quad (33)$$

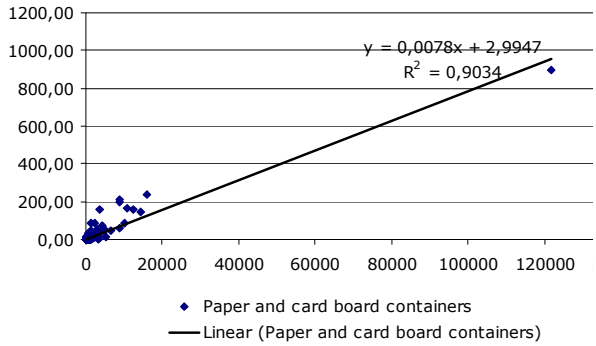

Fig. 8 Resulting LR line for $\hat{y}_{CW}$ (model 8D)

Based on the graphical illustration of the data there was also applied a polynomial trend (this trend curve is used when data fluctuates), that with regard to the fluctuation of data showed to be appropriate. On the base data file a higher value of the observed indicator ($R^2 = 0.8378$) was achieved. Upon exclusion of the statutory town Pardubice there was observed decline to ($R^2 = 0.8267$), when town Chrudim was excluded there was an increase ($R^2 = 0.8829$). Upon exclusion of both municipalities at the same time there was observed decline ($R^2 = 0.7471$) with regard to the basic data set. By exclusion of the above stated municipalities (see Table 11) a model was created (model 8D1) with the highest value of the indicator ($R^2 = 0.941$), regression equation (41) and a corresponding curve on Fig. 9. Table 13 shows selected results of modelling with the utilization of the polynomial trend.

Regression equation (34) corresponds to model 1D1, (35) model 2D1 , …, (41) the best model 8D1 and defines the predicted value of CW volume $\hat{y}_{CW}$ by the following way:

$$\hat{y}_{CM} = -9.6832 + 0.0241x - 1E\text{-}07x^2, \quad (34)$$
$$\hat{y}_{CM} = 1.045 + 0.0073x + 1E\text{-}06x^2, \quad (35)$$
$$\hat{y}_{CM} = -5.3745 + 0.0189x - 9E\text{-}08x^2, \quad (36)$$
$$\hat{y}_{CM} = -5.335 + 0.0189x - 9E\text{-}08x^2, \quad (37)$$
$$\hat{y}_{CM} = -4.5939 + 0.0175x - 8E\text{-}08x^2, \quad (38)$$
$$\hat{y}_{CM} = -4.5109 + 0.0171x - 8E\text{-}08x^2, \quad (39)$$
$$\hat{y}_{CM} = -3.9858 + 0.0161x - 7E\text{-}08x^2, \quad (40)$$
$$\hat{y}_{CM} = -2.7693 + 0.0141x - 6E\text{-}08x^2. \quad (41)$$

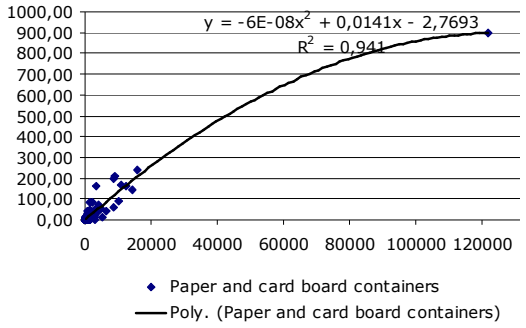

Fig. 9 Resulting regression curve polynomial trend for $\hat{y}_{CW}$ (model 8D1)

Table 13 CW polynomial regression analysis results

Model number	R^2	Description
1D1	0.8378	Data set - not excluded municipalities
2D1	0.8267	Data set without Pardubice
3D1	0.8829	Data set without Chrudim
4D1	0.7471	Data set without Pardubice, Chrudim
5D1	0.9118	Data set without Chrudim, Lanškroun
6D1	0.9161	Data set without Chrudim, Lanškroun, Letohrad
7D1	0.9272	Data set without Chrudim, Lanškroun, Letohrad, Litomyšl
8D1	0.941	Data set without Chrudim, Lanškroun, Letohrad, Litomyšl, Žamberk ,Svitavy

From the above stated it is clear that the polynomial trend represents a better approximation of the given data that reached quite visibly better R^2 values. Upon the exclusion of the statutory town Pardubice record and potentially the exclusion of some other municipalities the data, after graphic illustration, more pointed to a linear trend.

IV. Conclusion

The possibility to forecast MW volume is important especially for negotiation of contract conditions with waste collection and transportation companies. The estimated MW value jointly with other types of waste may serve to define the level of fees to be paid by municipality inhabitants as well as for reservation of sufficient municipal finance for this area from the municipal budget. And last but not least it allows to plan rent (or purchase) of new (larger or smaller) waste bins/containers and in case of separated waste also their number.

The achieved R^2 values than speak about the explanation of 98 % (98 %, 97 % and 90 %) variability of real data set speak about the usability or about the suitability of regression models for MW – the model 6A (PW – the model 12B, GW – the model 6C and CW – the model 8D) prediction on the regional level. It is possible to discuss application the polynomial trend represents

There is a decision making issue arising: to respect reality when modelling, that is to work with the status (real situation) in other municipalities and only exclude statutory town Pardubice, that dramatically differs in the number of inhabitants (there is about 5 times more inhabitants than in Chrudim) and where we can assume that the low value of the given variable is given by the fact that a large number of people does not separate paper and card board, and thus to select as the winning model the model (2D) with value R2 = 0.7639 which represents only 76.39 % of the explained variable, or to keep this model and to exclude other municipalities with higher number of inhabitants where the amount of paper and card board per 1 inhabitant is very high and to use model (8D) with observed indicator R^2 better by 0.1701, that is $R^2 = 0.9034$ that explains 90.34 % spread of the explained variable in case of the linear regression equation, or potentially to use model (8D1) with polynomial trend that explains up to 94.1 % spread of the volume of paper and card board in the observed municipalities.

In case of the variable Glass, also the polynomial trend was used based on detailed graphical illustration where very good results were obtained. With the resulting model the R^2 values for the polynomial and the linear trend reach high values (the difference is only 0.0182). To predict the volume of glass both models could be possibly used. However due to complexity of the calculation and also due to large rounding in the case of the polynomial trend the approximation under linear regression is more suitable despite the fact that before „cleansing“ it returns lower R^2 values.

In the future it is possible to deal with the issue of prediction by means of NNs, or potentially deal with municipality classification by the volume of MW, PW, GW and CW on the basis of cluster analysis.

References

[1] N. Adamičková, M. Königová, “Tisícovka i víc za svoz odpadu? Poslanci dali obcím volnou ruku” [The thousand and more for waste disposal? Members of the Parliament of the Czech Republic gave municipalities a free hand], *Právo: Nezávislé noviny*. Praha: Borgis, a.s., ISSN 1211-2119. (2012, April 04). 2012. (in Czech) [Online]. Available: http://www.novinky.cz/domaci/258592-tisicovka-i-vic-za-svoz-odpadu-poslanci-dali-obcim-volnou-ruku.html

[2] *Aktuality*. ČSÚ. Český statistický úřad [Czech Statistical Office], (2011, Oct. 15). 2011. (in Czech) [Online]. Available: http://www.czso.cz/xe/redakce.nsf/i/home

[3] R. Baťa, P. Kadlecová, “Modelování ekonomicko-environmentálních dopadů energetického využití papíru” [Modeling of economic and environmental impact of energy generation using of waste paper], *E+M Ekonomie a Management / E&M Economics and Management*, 2011, No. 2, Vol. XIV, pp. 90-98. ISSN 1212-3609. (in Czech)

[4] B. Černík, L. Benešová, M. Doležalová, “Prognóza vývoje odpadového hospodářství ČR” [Waste management forecasting in the Czech republic]. *Odpadové fórum: Waste forum*. 2011, No. 5, pp. 461-471. ISSN 1212-779. (2012, April 01). (in Czech) [Online]. Available: http://www.wasteforum.cz/cisla/WF_5_2010.pdf

[5] *Česká televize* [online]. c1996-2010 [cit. 2010-01-25]. “Nedej se” [Do not be] (2010, Jan. 25). (in Czech) [Online]. Available: http://www.ceskatelevize.cz/program/10267429305-11.02.2010-09:25-2-nedejse.html?online=1

[6] P. Hebák, *Regrese* [Regression]. Vyd. 1. Praha: Vysoká škola ekonomická v Praze, 1998, 138 pp. ISBN 80-707-9909-9. (in Czech)
[7] M. Hejča, J. Hřebíček, "Primary Environmental Data Quality Model: Proposal of a Prototype of Model Concept", *iEMSs 2008: International Congress on Environmental Modelling and Software Integrating Sciences and Information Technology for Environmental Assessment and Decision Making 4th Biennial Meeting of iEMSs*, M. Sànchez-Marrè, J. Béjar, J. Comas, A. Rizzoli and G. Guariso (Eds.) International Environmental Modelling and Software Society (iEMSs). 2008. [Online]. Available: http://www.iemss.org/iemss2008/index.php?n=Main.Proceedings
[8] J. Hřebíček, J. Soukopová, "Integrated Model of Municipal Waste Management of the Czech Republic", *International Congress on Environmental Modelling and Software Modelling for Environment's Sake, Fifth Biennial Meeting*, Ottawa, Canada David A. Swayne, Wanhong Yang, A. A. Voinov, A. Rizzoli, T. Filatova (Eds.), International Environmental Modelling and Software Society (iEMSs) 2010. [Online]. Available: http://www.iemss.org/iemss2010/index.php?n=Main.Proceedings
[9] Informační systém odpadového hospodářství (ISOH) [Information system of waste management], *CENIA*. (2012, Febr. 26). 2006. (in Czech) [Online]. Available: http://www.cenia.cz/web/www/webpub2nsf/$pid/CENMSFURMQON
[10] I. Knížková, *Modelování vybrané části životního prostředí. Modely odpadového hospodářství obcí Pardubického kraje* [The modelling of selected parts of the environment. Municipalities waste management models in the Pardubice region]. Pardubice, Fakulta ekonomicko-správní, Univerzita Pardubice, 2012, 116 pp. (in Czech)
[11] J. Křupka, I. Knížková, M. Kašparová, "Data Analysis of Municipal Solid Waste Models", *Recent Sesearches in Environmental and Geological Sciences*, *Proc. of the 7th WSEAS International Conference on Energy, & Environment (EE '12)*, Kos Island, Greece, July 14-17, 2012, WSEAS Press, N. Altawell, K. Volkov, C. Matos, P.F. de Arroyabe (Eds.), 2012, pp. 217-222.
[12] M. Kuraš, Optimalizace následné péče o skládky odpadů [Optimization of after-care of landfills], *Odpadové fórum: Waste forum*. 2011, No. 2, pp. 22-23. ISSN 1212-779. (2012, Aug. 03). (in Czech) [Online]. Available: http://www.odpadoveforum.cz/2011/22011.pdf
[13] *Ministerstvo životního prostředí* [Ministry of Environment CR]. "Rozšířené teze rozvoje odpadového hospodářství v ČR" [Advanced thesis of development of waste management in the Czech republic]. 52 pp. (2012, April 04). 2010.(in Czech) [Online]. Available: http://www.mzp.cz/cz/rozvoj_odpadoveho_hospodarstvi
[14] Ministerstvo životního prostředí. [Ministry of Environment CR]. STATUT rady pro odpadové hospodářství. MŽP, 2010, 2010 (2011 Oct. 10). (in Czech) [Online]. Available: http://www.mzp.cz/cz/rada_odpadoveho_hospodarstvi
[15] Ministerstvo životního prostředí: [Ministry of Environment CR]. Historie a poslání MŽP. Ministerstvo životního prostředí [online]. © 2008-2011 (2011 Dec. 28). (in Czech) [Online]. Available: http://www.mzp.cz/cz/ministerstvo
[16] L. Nondek, "Matematické modely nejsou na hraní" [Mathematical models are not playing]. *Odpadové forum: odborný měsíčník o odpadech a druhotných surovinách* [Waste Management Forum: Specialised monthly journal o n wastes and secondary materials]:. České ekologické manažerské centrum, 2011, No. 6, pp. 14-16. ISSN 1212-7779. (in Czech)
[17] O společnosti systému EKO-KOM. EKO-KOM, © 2011 (2012, Jan. 28). (in Czech) [Online]. Available: http://www.ekokom.cz/cz/ostatni/o-spolecnosti/systemekokom/o-systemu
[18] D.N. Ogbonna, G.T. Amangabara, T.O, Ekere, "Urban solid waste generation in Port Harcourt metropolis and its implications for waste management", *Management of Environmental Quality: An International Journal*. 2007, Vol. 18, Iss. 1, pp. 71-88.
[19] L. Olson, J. Arvai, L. Thorp, "Mental models research to inform community outreach for a campus recycling program", *International Journal of Sustainability in Higher Education*, 2011, Vol. 12, Iss. 4, pp. 322-337.
[20] I. Para, D. Stanciu, "Timisoara's Waste Sorting Station", *Recent Sesearches in Environmental and Geological Sciences*, *Proc. of the 7th WSEAS International Conference on Energy, & Environment (EE '12)*, Kos Island, Greece, July 14-17, 2012, WSEAS Press, N. Altawell, K. Volkov, C. Matos, P.F. de Arroyabe (Eds.), 2012, pp. 52-56.
[21] H.I. Park, Y.T. Kim, "Prediction of strength of reinforced lightweight soil using an artificial neural network", *Engineering Computations*, 2011, Vol. 28, Iss. 5, pp. 600-615.
[22] P. Plíva, "Všechno kolem kompostovacích ploch" [Everything around composting sites]. *Odpadové fórum: Waste forum*. 2011, No. 3. pp. 17-19. ISSN 1212-779. (in Czech)
[23] F. Rhoma, Z. Zhang, Y. Luo, B.Noche, "Environmental & Economical Optimization for Municipal Solid Waste Collection Problems, a Modeling and Algorithmic Approach Case Study", *Proc. of the 12th WSEAS International Conference on Mathematical Methods, Computational Techniques And Intelligent Systems (MAMECTIS '10)*, Kantaoui, Sousse, Tunisia, 2010 May 3-6, 2010, pp. 205-211.
[24] B. Sekerka, R. Bata, "Linear Models in Regional and Interregional Modeling", *WSEAS Transactions on Mathematics*, 2011, Vol. 10, Iss. 1, pp. 32-46.
[25] M. Vrbová, Odpady v obcích: Rozdíly mezi náklady a příjmy jsou obrovské. Regionální odpadové centrum Pardubického kraje [online]. ©2006-2010 [cit. 2012-02-26]. (in Czech) [Online]. Available: http://www.odpadypk.cz/index.php/aktuality/clanky/188-odpady-v-obcich-rozdily-mezi-naklady-a-pijmy-jsou-obrovske.html
[26] *Zákon č.185/2001 Sb., o odpadech a o změně některých dalších zákonů* [Law No. 185/2001 about waste]. [online]. (in Czech) [Online]. Available: http://www.mzp.cz/www/platnalegislativa.nsf/d79c09c54250df0dc1256e8900296e32/8fc3e5c15334ab9dc125727b00339581?OpenDocument

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