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ODOUR MANAGEMENT DECISION SUPPORT SYSTEM FOR LICENSING AUTHORITIES

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ABSTRACT

It is reported about a pilot project, aimed to speed up and to simplify the licensing processes by providing a tool to the licensing authorities for a first quick assessment of the importance of odour emitting plants. The tool, called GERDA, presently covers a choice of 5 different kinds of plants. The user feeds in the relevant data of the plant and the coordinates of its location within the State of Baden-Wuerttemberg. As output the system provides a kind of traffic light assessment on a map of the area around the plant with 3 colours according to the impact of the plant.

Key Words: Air quality, odour management, decision support, emission modelling, dispersion modelling

1. INTRODUCTION

Licencing processes have to be handled without delay. To speed them up, the German State of Baden-Wuerttemberg financed a pilot project which aims to bring together and to combine in a PC program the available knowledge of typical emissions of plants and the available (for Baden-Wuerttemberg area covering) information about dispersion conditions and land use as well as the German limit values for the frequency of odour concentrations in the vicinity of plants (GIRL 2004). The user should only have to input the relevant data of the plant and its location. As output he should get the assessment on a map of the area around the plant with the 3 colours red, yellow and green as a kind of traffic light assessment. The tool should allow to differentiate between plants with unimportant emissions, where the license in respect to odours may be granted without further delay and cases, where the authorities should insist on detailed studies. The tool will not replace detailed studies, it will only indicate their necessity. The first step of the project was to provide such a tool for a choice of 5 types of plants, considered by the licensing agencies to be important for the execution of their tasks.

To find out the most important plants, a poll was executed, asking the agencies which types of plants they wanted to be covered. On this basis it was decided to cover biological solid waste composting plants, repair paint shops, smokehouses, sewage treatment plants and foundries.
The Ministry of the Environment wanted to have the tool as a PC program with a user friendly surface and a calculation time of less than 12 minutes. For quality assurance purposes the output should contain a protocol of the input data and the emissions should be displayed for the different modules of the plant in a way, that a simple control of the calculation is possible. Additionally the durations of the emissions should be provided separately as continuous emissions, emissions only arising during working hours, emissions arising during certain actions as turning over of compost piles etc. as they are needed for a subsequent dispersion calculation. The meteorological parameters of the location should be assigned automatically as they are available area covering for Baden-Wuerttemberg in a high areal density. For the dispersion calculation, the system AUSTAL2000 (TA Luft, 2002) and GIRL (2004) had to be used, the official model for licensing procedures and odour assessments in Germany.

2. GERDA, WASTE TREATMENT PLANT AS EXAMPLE

2.1 Emission calculation

a) Input

The following illustrations concentrates on the biological waste composting plants as this type of plants is presently elaborated most in GERDA. Fig. 1 shows as an example the part of the input screen for the delivery section of a plant.

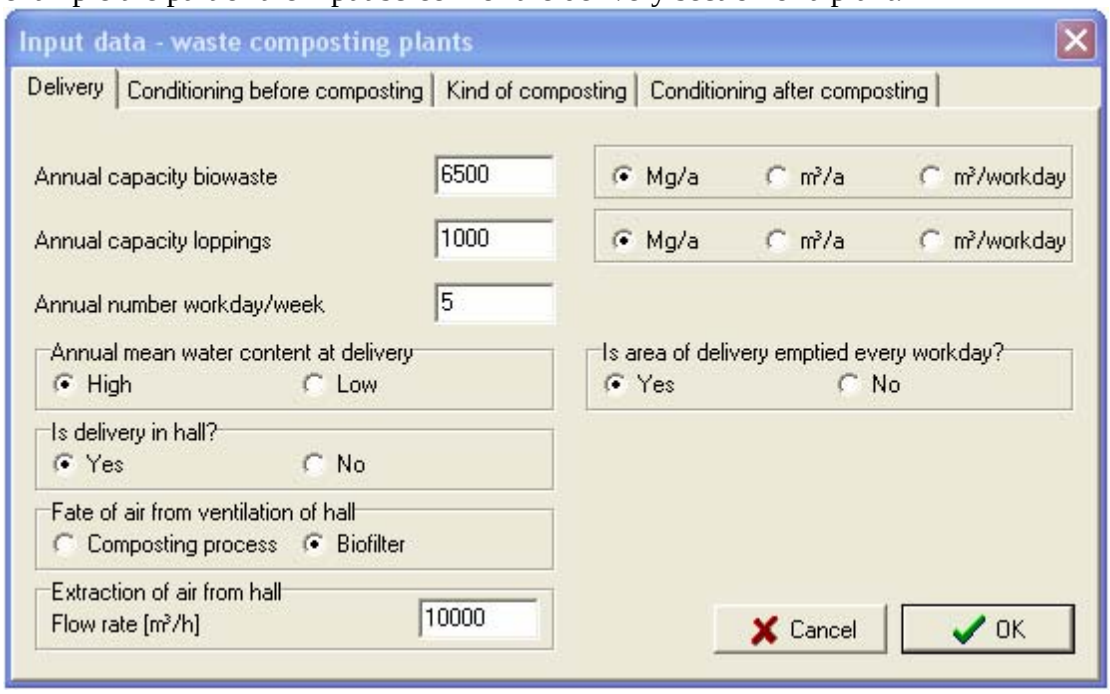


Figure 1: Input screen for waste composting plants, section delivery

It allows the input in the commonly used units Mg/a, m^3/a and m^3/workday. The questions about the number of workdays / week and whether the area of delivery is emptied every workday is needed for the calculation of the duration of the emission. The question concerning the water content of the material at delivery provides input to the selection of the emission factor. High water content might cause a higher emission factor. In case the question “Is delivery in hall” is answered “no”, all emissions of the delivery section are released into the atmosphere and no further questions are asked. But if the answer is “yes”, the last 2 questions appear on the screen asking first for the fate of the air from the hall. This air might be used for the forced aeration during the composting process or it might be conducted to the deodorizing bio filter. In both cases the flow rate of the air, out of the hall, needs to be known.
As can be seen from the top line in Fig. 1, input screens exist for the delivery, the section for conditioning before composting, the kind of (main) composting and the conditioning after composting. So it is helped to the user, to a) have a tool for an input of the data and b) to additionally have a kind of check list which shows the parameters needed for the input. Both points are important to support the quality of the estimation.

b) Output: Protocol of input
Fig. 2 shows part (rest is cut off) of the protocol of the input data, provided by the program together with the calculated emissions. All input data are contained in the protocol.

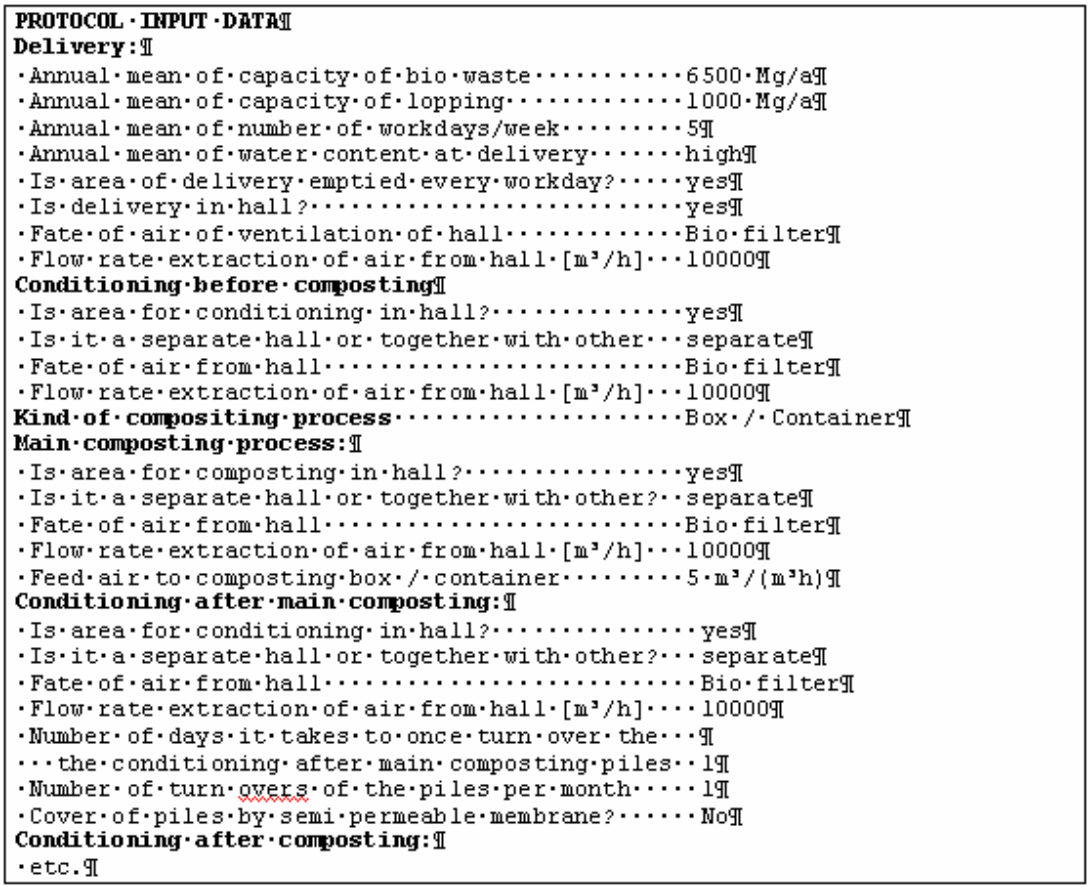
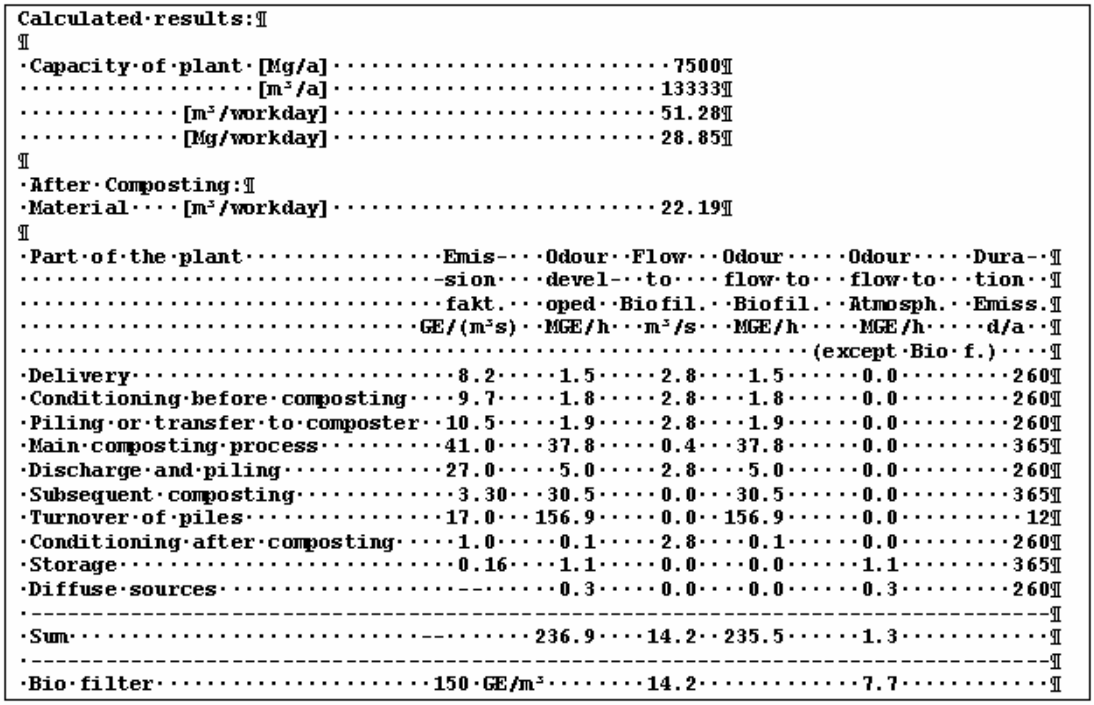


Figure 2: Part of input data documentation protocol for project with input screen as Fig.1

In Figure 2, the input data from Fig. 1 can be seen plus the additional data provided to the program via the other screens. It is structured in a way to allow a simple overview, in order to simplify the detection of inputs which might not be plausible.

c) Output: protocol emissions calculated

Fig. 3 shows the output protocol of the emission calculation for every part of the plant together with the emission factors selected by the program, the odours developed and where they go: Into the bio filter, into the main composting process or into the atmosphere. It can be seen that the duration of the emissions by single parts of the plant or single actions are quite different. The 260 day emissions are those arising during working days, the 365 day emissions are continuous emissions and the emissions arising 12 days arise by the once a month turning over of the piles taking 1 day per turnover in the example displayed. Differences between emissions in summer and winter are not considered in the program. The emissions of the bio filter are kept separate as they are treated differently by the different authorities in Germany.



Calculated results:

Capacity of plant [Mg/a]						7500
	[m³/a]					13333
	[m³/workday]					51.28
	[Mg/workday]					28.85
After Composting:						
Material	[m³/workday]					22.19
Part of the plant	Emission fakt. GE/(m³s)	Odour devel-oped MGE/h	Flow to Biofil. m³/s	Odour to Biofil. MGE/h	Odour flow to Atmosph. MGE/h	Duration Emiss. d/a
						(except Bio f.)
Delivery	8.2	1.5	2.8	1.5	0.0	260
Conditioning before composting	9.7	1.8	2.8	1.8	0.0	260
Piling or transfer to composter	10.5	1.9	2.8	1.9	0.0	260
Main composting process	41.0	37.8	0.4	37.8	0.0	365
Discharge and piling	27.0	5.0	2.8	5.0	0.0	260
Subsequent composting	3.30	30.5	0.0	30.5	0.0	365
Turnover of piles	17.0	156.9	0.0	156.9	0.0	12
Conditioning after composting	1.0	0.1	2.8	0.1	0.0	260
Storage	0.16	1.1	0.0	0.0	1.1	365
Diffuse sources	--	0.3	0.0	0.0	0.3	260
Sum	--	236.9	14.2	235.5	1.3	
Bio filter	150 GE/m³		14.2		7.7	

Figure 3: Typical output protocol of emission calculation for waste composting plant

2.2 Dispersion calculation

The dispersion calculation is done on the basis of the system AUSTAL2000, the official model for licensing procedures and odour assessments in Germany. Depending on the complexity of the input parameters, the regular calculation time on a regular PC is several hours, say 6 hours for a regular waste composting plant for an assessment area of 2 km by 2 km. In order to meet the demanded calculation time of 12 minutes, some time consuming parameters were excluded: Influence of topography is not respected by a three dimensional flow field but via the meteorological input data (three dimensional dispersion class statistics), dispersion categories statistics only contain three stability classes (stable, neutral unstable) instead of the regular 6 classes, no influence of buildings is possible, maximum stack height is 30 m (thus only small areas of assessment are necessary), minimum grid size of area of assessment is 50m by 50m and only a minimum of particles is released for the Lagrangian dispersion calculation. Therefore quite some advantages of the new German AUSTAL2000 procedure in comparison to Gaussian dispersion calculation were lost, but it was important for the project to basically build upon the new regulatory model.

2.3 Display of final results

Figure 4 shows the display of the final result for a plant emitting 200 MGE/h on the basis of the odour perception limit values for residential areas. For the red area (dark grey in this paper), the limit values for the frequency of odour perceptions in industrial areas might be exceeded. Within the yellow area (light grey), exceedances of the limit values for residential areas are estimated to be as likely as they are not,

i.e. in case living quarters exist in this area, the licensing authority will demand more detailed studies. In case living quarters only exist within the green areas (white in this paper), the odour part of the project can be waved through.

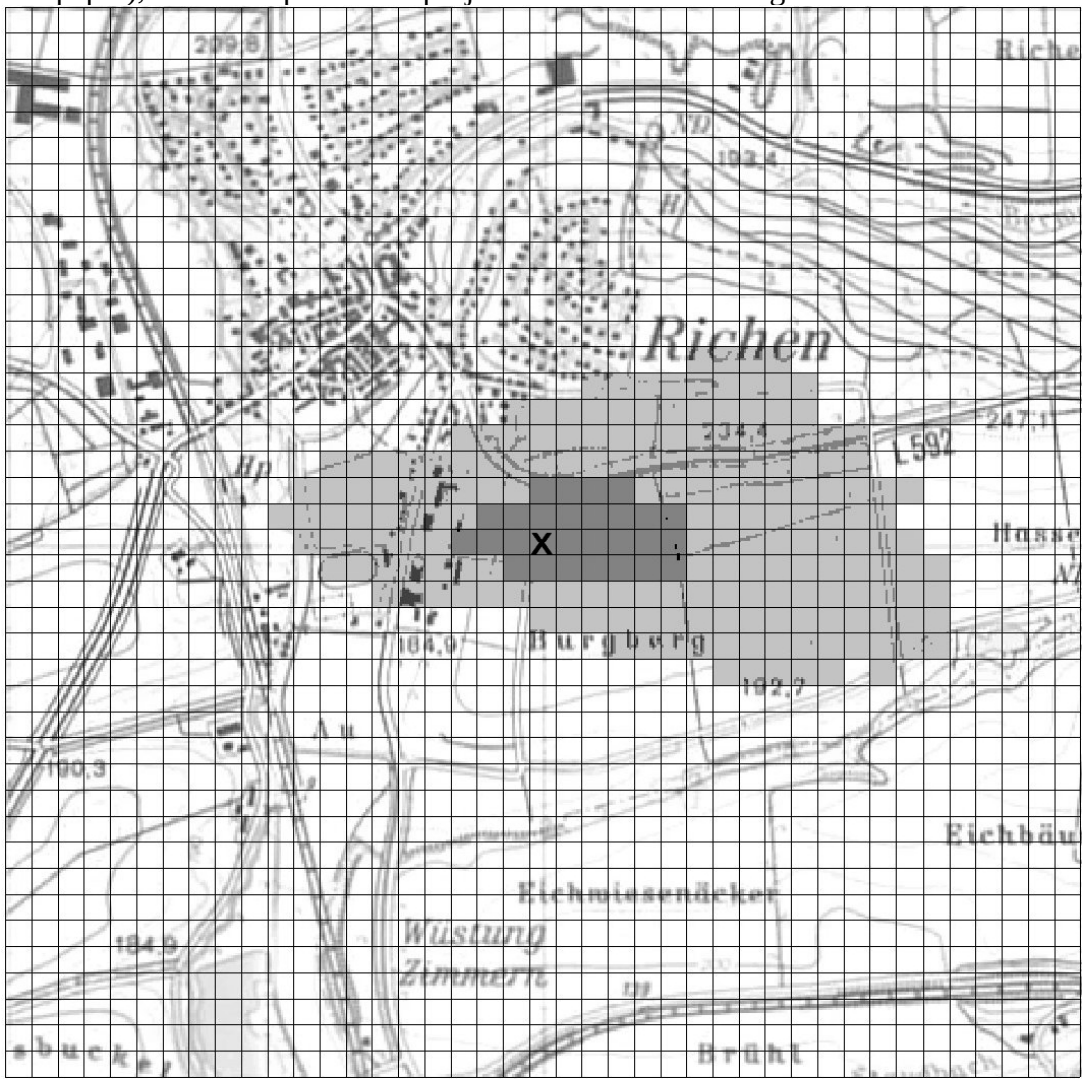


Figure 4: Display of result for residential areas. Dark grey: limit values are very likely to be exceeded. Light grey: exceedances are estimated to be as likely as they are not, i.e. more detailed studies are needed.

3. DATA USED AND VALIDATION

Presently, the dispersion part of GERDA is under development and not yet validated, but the emission part was finished some time ago and got some first validation. The data used for the determination of the emissions of the biological waste composting plants mostly come from the work of Bidlingmaier et al., 1997, which systematically collected this kind of data for different plants and created a sort of calculation sheet to determine the emissions in a concerted way. These data were enriched for GERDA by material in Homans and Bardtke, 1993 and VDI 3475, Part 1, 2003.
It is very important to note, that Bidlingmaier addresses in Bildingsmaier et al., 1997 the necessity to

- collect and include more data,
- annually update the data base,
- keep a data base with concerted data, i.e. data which are agreed in the community.

As GERDA has the character of a pilot study, it is its main aim the show that it is possible to create such a tool, that the expectations of the users basically can be met, that they can identify their plant in the program. Questions as a sophisticated validation of the calculated emissions and the securing of a continuous updating only were in the background. Deviations of the calculated emissions from the real emissions are therefore of minor damage. Seven first comparisons show in this respect

- for 2 of the comparisons an underestimation by the calculation and for 5 comparisons an overestimation
- for 2 of the comparisons, that are approx. 30 % of the comparisons, a deviation between calculation and measurement < $\pm$ 50 %, for 6 of the 7 comparisons, that are approx. 85 % of the comparisons, a deviation < $\pm$ a factor of 4.

GERDA is presently only validated by the above mentioned 7 comparisons, i.e. for quality assurance no systematic comparison has been executed between results of field measurements and results of the program for data sets which were not used for the development of the program. Such a validation therefore is recommended to each user.

4. AVAILABILITY AND MAINTENANCE

Presently the emission part of GERDA is used by the relevant authorities in Baden-Württemberg and it was made accessible by the Baden-Württemberg Ministry of the Environment to the authorities in the other German states. All costs for the development of this part were provided by the ministry, but the ministry is not able to distribute the GERDA CD and handbook to all interested parties and to provide advise, delivery, hotline etc. For that Lohmeyer Consulting GmbH & Co. KG was contracted and the ministry agreed that only a nominal fee of EUR 75.- (incl. VAT) is charged per order. See http://www.lohmeyer.de/eng/Software/Gerda/gerda.htm for further information.

5. FUTURE ACTIVITIES AND VISION

As already addressed by Bidlingmaier et al., 1997 it is important just not to have GERDA developed and let it be as it is. In this case it will get more and more outdated and it will slowly disappear. All the effort invested would be wasted. What needs to be done instead is (together with the already existing service) to secure continuity , to ensure validation, upgrades and updates and a web page for frequently asked questions, to enrich GERDA by additional types of plants and meteorological information outside Baden-Württemberg, to make it available for use all over Europe and to have it accompanied by a group of experts. The idea and vision for this accompanying expert group is as follows: A group of experts accompanying GERDA should be formed, consisting of persons from authorities, science and consulting. They should meet unsalaried 1 to 2 times per year, should observe new developments and the state of the art, should ensure a procedure within GERDA which is in concert with the community and should decide about upgrades, updates, enrichments, validations etc. This would give continuity, quality, reputation and acceptance to GERDA and would ease the raising of funds necessary to execute the upcoming tasks.
In case of interest to take part in such an expert group or the availability of a “full” high quality validation data set for the type of plants covered by GERDA, please mail to the corresponding author Achim.Lohmeyer@Lohmeyer.de.

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