News from Lohmeyer

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Dear Readers

The year is drawing to a close and we would like to share with you several articles on selected issues that have kept us busy in 2016.

The first article in this newsletter reports on the update we carried out on the GERDA odor emission determination module at the request of the Baden-Württemberg Regional Office for Environment, Measurements and Nature Conservation.

As part of a project for the Federal Environment Agency, we were able to compare and systematize various methods used in Europe and the U.S. for modeling abrasion and the resuspension of traffic-induced fine particulate emissions in order to provide a qualified proposal for integration in the Handbook Emission Factors for Road Transport (HBEFA). We also applied the NORTRIP model, which gives a detailed description of the underlying physical mechanisms. The second article in this issue summarizes the results of the project and its recommendations.

In the last few years, we have gained a great deal of knowledge about determining traffic-induced emissions, particularly about the impact of driving dynamics, through real-life test drives and through the use of the detailed PHEM emission model. Our findings have helped make our emissions determination method more realistic. A very special case study regarding the 30 km/h speed limit on main roads is the subject of our third article.

I hope you find these topics interesting and I wish you all a joyful and peaceful Christmas season and a happy new year.

Yours sincerely

WE WOULD LIKE TO THANK YOU FOR INTERESTING PROJECTS, INSPIRING DISCUSSIONS AND OUTSTANDING TRUST AND COOPERATION!

MERRY CHRISTMAS AND A HAPPY NEW YEAR!

BRIEF SUMMARY OF CURRENT NEWS

- October 2016 saw the launch of the UFOPLAN project 3716 52 200 0, “Impact of a major airport on the seasonal and spatial distributions of outdoor air concentrations of ultra-fine particulate < 100 nm in order to describe potential nuisance in close proximity – taking into account additional air pollutants (soot, nitrogen oxides and particulate matter (PM2.5 and PM10)).” The immissions are determined using model calculations and validated via measured data. Our office is coordinating the project and performing part of the model calculations.
- Drones (e.g. octocopters or quadcopters) are now increasingly being used to measure air pollutants. Providers of such systems assert that this method enables pollutant concentrations to be measured along predetermined routes or at certain set points. Commissioned by the Federal Highway Research Institute (BASt), our office has begun working on a project together with the Fraunhofer Institute in Dresden and the Leibniz Institute for Tropospheric Research in Leipzig.
- The article “Stickstoffeinträge in empfindliche FFH-Gebiete durch den Kfz-Verkehr - zeitliche Veränderungen im Hinblick auf das Abschneidekriterium“ (Nagel/Lorenz) is set to appear in the 1/2017 (March) edition of the journal „Immissionsschutz“.
- For SAMS Global (a system for calculating immissions after accidental release), an update with online map integration for OpenStreetMap, GoogleMaps and the WMS server is available. For more information on this, please contact Tilo Hoffmann (+49 351/83914-19, Tilo.Hoffmann@lohmeyer.de)

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GERDA IV – UPDATE FOR SCREENING TOOL USED BY BADEN-WÜRTTEMBERG AUTHORITIES TO ESTIMATE THE RELEVANCE IN TERMS OF IMMISSIONS OF ODORS FROM SIX PLANT TYPES

At the beginning of the planning procedure for the construction of a plant or the development of a building area, questions regarding the relevance of potential odor immissions frequently come up.

To estimate odor emissions, or immissions caused by smokehouses, compost areas, sewage treatment plants, paint shops or foundries, in this early phase, the GERDA [1] and then GERDA II [2] screening tools were developed. In the GERDA III [3] update, biogas facilities were added as a plant type and integrated into the screening tool. In principle, this version also allows users to input odor emission figures for other emission sources. This year, the emissions estimates for the six plant types included in GERDA IV [4] were once again revised.

GERDA IV is a screening procedure that uses conservative methods. Like its previous versions, it is not intended to replace expert advice, but simply to provide an indication as to whether expert advice is necessary or not. Furthermore, GERDA IV can be used to generate rough estimates of preload pollution sources.

GERDA IV has a program interface which allows users to enter the input data required for preparing an emissions estimate for any one of the six possible plant types. The amount of necessary input data is kept as low as possible and is limited to what is already available in the early planning stage.

The odor immissions are calculated as odor hour frequency, which is the percentage of odor hours in a year. The calculation is based on AUSTAL2000, the reference model of TA Luft (Germany's air pollution regulation: Technical Instructions on Air Quality Control, 2002), but in screening quality with low computing times. In Baden-Württemberg, synthetic wind statistics are provided in GERDA for this purpose. The results include both a report on the emissions estimate and a colorful, area-wide immissions graphic with background map. The immissions are shown on a computation grid; the color shades in the legend are limited to > 10 % and > 15 % or > 8 % and > 25 % respectively of the annual odor hour frequency. This can be used to check, for example, the expected compliance or non-compliance of the immission values with the odor immissions guideline for residential, mixed-use and trade areas. Statements on the compliance of the irrelevance are therefore not supported in GERDA IV. In order to arrive at results that are generally conservative in accordance with the screening approach, the GERDA IV results include an immissions-related safety margin. Nonetheless, GERDA IV's application limitations, which are caused by the simplifications carried out with a screening tool, must be observed. If applicable, these include the relevant impact of the relief, of nocturnal drainage, of building structures or of distances of less than 75 m between the source and the assessment point at a survey location.

When updating the emissions estimates for the six plant types from GERDA III to GERDA IV, the following changes were made based on bibliographical research:

The method of determining emissions for foundries was updated. Queries regarding the existence of waste gas final treatments for all foundry processes were integrated. The treatment of binding agents in core-making shop and casting line processes was adapted.

The emission factors estimated for the different plant sections in sewage treatment plants were updated based on [5], [6] and [7]. Rainwater retention reservoirs can now also be taken into account using the emission factor mentioned in [5].

The method of determining emissions for biogas facilities was revised using the current emission factors in [8] and [9]. The method of reducing emissions by covering fertilizer storage areas with artificial covers was adjusted to [8].

The process for determining odor emissions for waste composting systems, smokehouses and paint shops remains unchanged. Current research either has not yielded any reliable data that justifies changing the methods for these plant types, or supports the current approaches. The determining of emissions for winding wire coating shops was removed because there was too little reliable data. For the "Miscellaneous coating of metal and synthetic material", a note was included that GERDA IV is only suitable for application in situations where no crack products develop in the dryer and where odor emissions are determined by solvent emissions, i.e., not in powder varnish.

GERDA IV will be available for trained staff in the upper and lower immission control agencies as well as the agricultural management administration in Baden-Württemberg. Moreover, an update of the current sales version GERDA II (compare http://www.lohmeyer.de/en/content/software-sales-distribution/product-overview/gerda-ii) is scheduled for the near future, which means that changes in emissions estimation and the treatment of biogas facilities as specified in GERDA IV will be added to this version.

References:

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NORTRIP DETAIL MODEL FOR PM_x EMISSIONS FROM RESUSPENSION AND ABRASION – BENEFITS AND LIMITATIONS

Traffic-induced PMx emissions are caused by emissions from exhaust systems and by resuspension and abrasion emissions (AWAR). Currently, the PM10 AWAR emission factors as described in [1] are frequently used. They are differentiated according to vehicle classes (light- and heavy-duty vehicles) as well as traffic situations and level-of-service classes according to HBEFA 3.2.

Multiple studies have shown that the PM10 emissions from passenger car traffic can be additionally impacted by meteorological factors (e.g. rain), infrastructure-related factors (e.g. road surfaces) and other factors (e.g. de-icing services). These factors cannot be taken into account using the approach of (solid average) emission factors as described in [1].

As part of the NORTRIP project on non-exhaust road-traffic-induced particle emission modeling, the Scandinavian countries have presented a PMx emissions model for AWAR [2].

The following processes are quantified in this model:

- Direct emissions from abrasion processes
- Indirect emissions (resuspension) of road dust, sand and salt from de-icing services

The quantity of dust and salt on the roads is determined via mass balancing. The repositories and depressions for direct and indirect emissions are quantified by taking into consideration the meteorological as well as road surface conditions. This includes calculating the road cover moisture. The calculations are performed in a time series (1 hr mean values). For this purpose, representative meteorological and traffic-related time series are consulted for the road to be tested. The calculated road conditions (dust accumulation) are reused as the starting value for the following hour. Different road surfaces can be considered as variables, as can the concrete geometric situation of the road and, if necessary, de-icing service and street cleaning measures. In addition to traffic influences, this method thus allows regional and also annual meteorological differences, for example, to be quantified.

As part of the UBA project “Determining Vehicle Emission Factors Taking into Consideration Future Drive Concepts and the Upstream Motor Fuel Chain – Work Package 2: Emission Factors from Abrasion and Resuspension” (FKZ 3713 47 100), the NORTRIP model was tested for practicality by our office using sensitivity calculations for several roads, and comparisons with other emission approaches were also carried out. These tests resulted in the following findings:

Limits: Outside cities (at high vehicle speeds), the current version of NORTRIP (V2.8a) overestimates considerably. According to information from the model developers, the velocity dependence, derived from tests in the “road simulators,” is currently validated only up to 70 km/h. Therefore, to describe emission factors for most out-of-town traffic situations in HBEFA, NORTRIP is currently not suitable. Furthermore, using it for entire road networks in built-up areas is very time-consuming.

Benefits: NORTRIP is currently the only emissions model that can take into account the influences of meteorological and street geometry factors and, where relevant, of road surface conditions, de-icing services and street cleaning, thus providing the option of at least assessing their impact in relative terms. In built-up areas the calculated absolute AWAR emission factors compare to those described in [1] with good to satisfactory results. NORTRIP is therefore very well suited for detailed studies in built-up areas.

References:

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IMPACT OF A SPEED LIMIT REDUCTION FROM 50 KM/H (T50) TO 30 KM/H (T30) USING THE ZEPPELINSTRASSE IN POTSDAM AS AN EXAMPLE

Reducing the speed limit to 30 km/h on main roads is currently under discussion or already in practice in many cities. The impact of this on air pollutants is controversial because it depends heavily on route-specific features. In addition to the impacts described in [1], changes in real driving behavior from T50 to T30 are especially relevant. If, for example, the speed level in a T50 section of the road is only between 30 km/h and 40 km/h due to traffic flow disturbances, the pollution control potential is just as low as it would be at T30 if the speed level remained unchanged due to local conditions (e.g. wide, non-built-up road) and/or without speed-limit monitoring.

But even when the average speed decreases at T30, no emissions-related assessment can be made solely based on the speed differential because there are, in principle, two opposing effects occurring:

- when driving at a constant speed, the engine tends to emit slightly more NO_x at T30 than at T50,
- while in the acceleration phase, e.g. driving into the section or driving off from a standstill at traffic lights, emissions when accelerating to 50 km/h are considerably higher than when accelerating to a target speed of 30 km/h (see **Fig. 1**).

Accordingly, the phase in which the car is driven at a constant speed has a major impact because we can derive from it whether or to what extent the lower emissions when accelerating are compensated for by the slightly higher emissions while driving at constant speed at T30. An assessment of the emissions-related impacts of a T30 measure is therefore not possible across the board, but can only take place on specific roads, taking into consideration real driving behavior.

The driving behavior was therefore recorded as part of the investigation carried out on the Zeppelinstrasse using an LDV equipped with a “Peiseler test wheel VS.” It was used for the starting situation (T50) and for the T30 test drives. The result of each test drive was a measurement file with a certain number of values, recorded in seconds, for speed and the route or road section driven. All of the speed values recorded in one drive create a drive curve shown as a speed/time or a speed/route diagram. Based on these drive curves, the emission factors for all LDV emissions concepts were calculated using PHEM (passenger car and heavy duty emission model, from the University of Graz). In the evaluation, the following variables were taken into account: spatial differences in the streets at the “intersection” (roughly 100 m radius around the intersection) and areas in between (“section”), consideration of the adjustment of the coordination speed of the traffic lights which had not yet occurred, time of day of the driving behavior, and the impact of heavy-duty vehicles.

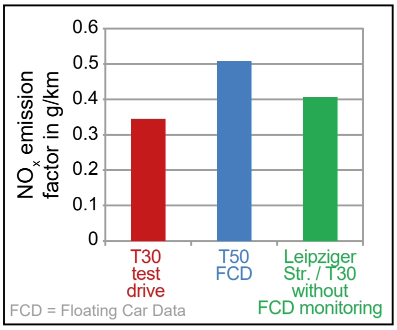

Fig. 1: *LDV emissions comparison at different acceleration speeds when driving off from a standstill at traffic lights*

To summarize, the following conclusion can be made: a speed limit reduction to 30 km/h can result in lower NO_x and PM10 emissions. This is true of the entire street as well as the majority of the street sections. The potential reductions derived as a result apply only if the speed limit of 30 km/h is adhered to one hundred percent. This means permanent speed-limit monitoring. Otherwise, the reduction figures will be lower. Furthermore, the traffic light coordination speed must be adjusted to match the speed limit of 30 km/h, because the potential reductions derived only apply under the condition that the “green wave” at T30 functions exactly as it does currently at T50. The potential reductions derived apply to LDV emissions. If heavy-duty vehicles are considered, the potential reductions will tend to be higher. The report can be downloaded at http://www.mlul.brandenburg.de/media_fast/4055/Bericht_Messfahrten_T30.pdf.

Furthermore, as already shown during our investigations in Berlin (see e.g. http://www.lohmeyer.de/de/system/files/content/download/hauszeitung/ausgabe34.pdf), this shows that for calculations for air pollution control measures in built-up areas, the traffic situations currently represented in the HBEFA are not sufficient to represent the real emission conditions. This affects, among other things, stop and acceleration movements at traffic junctions or acceleration movements during inflow into junctions or run-off out of junctions. But that is a different issue, which we look forward to addressing in one of our next newsletter issues.

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