New default values for the spray model

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Mass generation rate

Additional measurements have been performed for the mass generation rate of spray cans and trigger sprays (Tuinman, 2007). The newly obtained data are combined with the original dataset and used to derive new default values for the mass generation rate. The results of the new measurements and the new default values for the mass generation rate are described in Delmaar and Bremmer (2009). In table 1 the product categories, for which the default value for mass generation rate is changed, are described including the old and new values. The default values in table 1 are derived in exactly the same way as described in the Fact Sheets. In the Facts Sheets the mass generation rate is defined as the mean mass generation rate during the total time span of spraying. Therefore, most of the default values deviate from the values as described in Delmaar and Bremmer, where the mass generation during active spraying is given.

Particle size distribution

For particle size distributions of spray cans and trigger sprays additional measurements have been performed (Tuinman, 2007). The newly obtained data are combined with the original dataset. This combined dataset is used to describe particle size distributions.

New approach to describe the particle size distribution

Until now, lognormal distributions were used to describe the particle size distributions in the ConsExpo spray model. This is adequate/sufficient for the description of the entire distributions, however the fitted (lognormal) distribution for the entire particle size distribution results in a poor description of the smaller particles, which are the most critical for inhalation exposure. Exposure estimates using lognormal distribution fits for the entire distribution turned out to be inaccurate. Therefore an approach was developed, to better describe the distribution of the smaller particles.

In ConsExpo 4.1 only parametric distributions (either normal or lognormal distributions) can be used for input of the particle size distribution. As the smaller particles in the distribution are the most critical with respect to inhalation exposure, only the particle size distributions in the region of diameters up to 22.5 μm were fit to a lognormal distribution. It should be noted that such a fit of the distribution will not be valid for larger particle sizes.

In the new approach, the size distributions of the particles up to 22.5 μm of different products from the same product group were aggregated. For each size bin (i.e. every measured particle size) of this aggregate the 90-percentile value was calculated. A log-normal distribution was fit on the curve formed by all 90-percentile values.

Thus, for example, all deodorants, of which particle size distributions were measured (Tuinman, 2004; Tuinman, 2007), were grouped together. Every size of the particle size distribution was regarded as a statistical sample of the 'new default' deodorant particle

distribution. From the ensemble of deodorants a 90-percentile curve was constructed by taking the 90 percentile per particle diameter bin. To the resulting 90-percentiles curve a lognormal curve was fit.
This fitted distribution is chosen as a default distribution representing the particle size distribution of all deodorant sprays. The procedure of fitting is described in detail in Delmaar and Bremmer (2009). In this report default values are also given, which describe the particle size distribution for each product category (mean and coefficient of variation).
These newly derived default distributions, which represent the distribution of particles up to 22.5 µm for products in a product category, can't be used in the ConsExpo spray model directly. The particle distribution up to 22.5 µm, being only a fraction of the complete distribution, needs to be corrected with a scaling factor f_{scale}, which represents the mass fraction of the total sprayed product.
This scaling factor is not a separate factor in the ConsExpo model. In order to accommodate this factor, it is to be combined with the airborne fraction of the ConsExpo model. Therefore, this fraction now consists of two contributions: this scale factor f_{scale} and $f_{airborne}$, which was obtained from the fit of the model with the experimental data. Both factors are given separately but should be used as one aggregate factor in the ConsExpo calculations:

$$\text{Airborne fraction}_{new} = f_{airborne\ old} \times f_{scale}$$

More information, including default values for the f_{scale}, for all measured product categories, and the validation of this approach, can be found in Delmaar and Bremmer (2009).

In Table 1 new default values are given for the initial particle size distribution (mean and coefficient of variation), f_{scale} and the airborne fraction$_{new}$ for all spraying processes which are described in the fact sheets.

Delmaar, J.E., H.J. Bremmer 2009. The ConsExpo spray model. Modelling and experimental validation of the inhalation exposure of consumers to aerosols from spray cans and trigger sprays, RIVM Report 320104005/2009

Tuinman, I.L. (2004). Aerosols from Spray Cans and Trigger Sprays. Particle Size Distributions and Spreading in a Closed Environment. TNO report PML 2004-C106.

Tuinman, I.L. (2007). Particle size distributions of aerosols from spray cans and trigger sprays. TNO report august 2007.

Table 1: new default values for mass generation rate, airborne fraction and initial particle size distribution

Fact Sheet	Product category	Mass generation rate [g/sec}		$F_{airborne\ old}$ [g/g]	F_{scale} [g/g]	Airborne fraction $_{new}$ [g/g]	Initial droplet size distribution P_{50} [µm] (CV)	defaults for "F_{scale}" and "Initial droplet size distribution" derived from ….
		Old	New 1)					
Paints	spray can	0.33	0.45	1	0.7	0.7	15.1 (1.2)	
	pneumatic	0.5	**	0.2	--	--	--	Paint, spray can
Cosmetics	hair spray	0.47	0.4	1	0.2	0.2	46.5 (2.1)	
	hair dye spray	0.47	0.4	1	--	--	--	Hair spray
	deodorant spray	0.4	0.45	1	0.9	0.9	8.3 (0.84)	
	eau de toilette spray	0.14	0.1	0.2	0.1	0.02	2.7 (0.73)	
Disinfectants	algea remover spray	5.0	**	0.2	--	--	--	Pest control, trigger plant spray fine
	mould remover spray	0.75	0.8	0.2	--	--	--	Pest control, trigger, ready to use
	disinfectant spray, indoor use	0.75	0.8	0.2	--	--	--	Pest control, trigger, ready to use
	disinfectants for animal transports	5.0	**	0.2	--	--	--	Pest control, trigger plant spray fine
	disinfectants for water coolers	0.36	0.2	0.2	--	--	--	Pest control, trigger plant spray fine
Pest control products	spray can, targeted spot, crack and crevice	0.38	0.55	1	0.2	0.2	3.6 (0.57)	
	spray can, general surface	0.75	1.1	1	0.2	0.2	3.6 (0.57)	
	trigger spray, ready to use, general surface	0.75	0.8	0.2	0.04	0.008	7.7 (1.9)	
	trigger spray, ready to use, targeted spot, crack and crevice	0.38	0.4	0.2	0.04	0.008	7.7 (1.9)	
	trigger spray, plant spray fine	0.38	0.4	0.2	0.09	0.02	2.0 (0.39)	
	air space, spray can	0.75	1.1	1	0.3	0.3	28.2 (1.6)	
	electrical evaporators	2.2E-5	**	1	--	1	**	$F_{airborne\ new}$ default
	dusting powders	0.2	**	0.2	--	--	--	Pest control, trigger plant spray fine
Cleaning products	spray spot remover (trigger)	1.5	1.6	0.2	--	--	--	Trigger , all purpose cleaner
	all purpose cleaner (trigger)	0.78	0.8	0.2	0.03	0.006	2.4 (0.37)	
	scattering abrasive powder	0.62	**	0.2	--	--	--	Pest control, trigger plant spray fine
	bathroom cleaner (trigger)	0.39	0.8	0.2	0.009	0.002	3.6 (0.52)	
	scattering carpet powder	1.7	**	0.2	--	--	--	Pest control, trigger plant spray fine
	furniture spray (spray can)	0.75	0.6	1	0.3	0.3	10.8 (0.81)	
	glass cleaner (trigger)	0.78	0.8	0.2	--	--	--	All purpose cleaner (trigger)
	oven cleaner (trigger)	0.78	0.8	0.2	--	--	--	All purpose cleaner (trigger)
	shoe polish spray (spray can)	0.5	0.4	1	--	--	--	Paint, spray can
Do-It-Yourself products	glue from spray (spray can)	1.5	1.2	1	--	--	--	Paint, spray can
	putty from spray (spray can)	1.5	1.2	1	--	--	--	Paint, spray can

-- no calculated value

1) for some product categories the default value for the mass generation rate is divided by a factor 2, 3 or 4, caused by the fact that in the fact sheets the mass generation rate is defined as de mean mass generation rate, during the time span of active spraying

** no new value, old value can be used.

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