The assessment of direct emission to surface water in urban areas (PT 6.2/6.3 and 7-10)

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Note to the reader

During the discussion about Tebuconazol PT 7 and 10 at TM IV-2012, DE agreed to present to the TM a proposal for a scenario on direct emissions to surface water via rainfall or storm water events, respectively. The document was presented and discussed at TM II-2013. After the discussion, DE received useful comments from NL and FR. Their suggestions and improvements were incorporated in the document. The document was discussed again at WG III-2014 and finally endorsed by the WG members. It was decided to keep the dilution factor of 10. The dilution factor may be revised in the future in the light of further experience. The parameter F_{deg} describing the fraction of the active substance that is degraded on the way from the entrance of the sewer to the surface water was deleted.

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Introduction

Active substances with intended outdoor use in PT 6.2/6.3, 7, 8, 9 or 10 are accessible to leaching by the rainwater from façades and roofs. Then, in urban areas, the rainwater is collected in the sewer system. At the moment the environmental release estimation (and subsequently the environmental exposure assessment) assumes that always a mixed sewer system is present and that the active substances enter a sewage treatment plant. A harmonised assessment of direct emissions to surface water is currently not available. However, two emission pathways must be distinguished and considered: (a) direct emission due to storm water and (b) separate sewer systems with direct discharge of rainwater.

Direct emission due to storm water means that, in case of heavy weather situations, wastewater plus rainwater will be discharged directly to surface water bodies in order to relieve the sewage treatment plant (STP) and the sewer system (called bypass of STP). For Germany, it was estimated that per year about 2.6% of wastewater are released directly to surface water as a result of storm water events.

Separate sewer systems in which rainwater and wastewater are separately collected are another issue. Wastewater is treated in a STP. Rainwater is (in most cases) not treated and may be discharged directly to surface water bodies if no rainwater detention reservoir is in between. Active substances with intended outdoor use in PT 6.2/6.3 and 7 to 10 may be leached by the rainwater from façades and roofs. Therefore, they will be collected in the rainwater sewer. In Germany, about 40% of the total number of sewer systems are separated sewer systems. The separated sewer system type is not found in all parts of Germany. Whereas in the Northern part of the country up to 80% of the sewer systems are separate ones, in some of the Western and Southern regions of Germany the mixed system type makes up to 100% of public canalisation. This illustrates that it is important to consider direct emission due to separate sewer systems on the local level in Germany. In France, the distribution between the different systems is the following: 97 000 km (24.7%) for combined sewers, 200 000 km (51%) for waste water sewers (in separate sewer systems) and 95 000 km (24%) for rain water sewers (in separate sewer systems). These figures were for 2008 and they are on the increase for separate sewer systems.

Bypass of STP (mixed sewer system)

In case of storm water events, wastewater plus rainwater from mixed sewer systems will be discharged directly to surface water bodies in order to relieve the STP. The EU TGD, part 2 (chapter 2.3.7.1, page 63, 2003) states: “For calculating the PEC in surface water without sewage treatment, the fraction of the emission to wastewater, directed to effluent ($Fstp_{water}$) should be set to 1. The fractions to air and sludge ($Fstp_{air}$ and $Fstp_{sludge}$ resp.) should be set to zero”.

If $Fstp_{water}$ is set to 1, the concentration in untreated waste water ($Clocal_{inf}$) is equal to the concentration in the STP effluent ($Clocal_{eff}$) which is the same as if there is no STP. The dilution of the local emission in wastewater is still 2000 m^3 per day which is supposed to be a worst case for the storm water event.

Remark: By using the bypass STP scenario in EUSES, $Fstp_{water}$ is set to 1. Therefore, it is correct to adopt a bypass scenario to consider storm water events.

Scenario “Bypass of STP (mixed sewer systems)”

$$Clocal_{eff} = Elocal_{wastewater} / EFFLUENT_{wastewater} \quad (1)$$

where:

$Elocal_{wastewater}$	daily emission to wastewater sewer	[kg d^{-1}]	#
$EFFLUENT_{wastewater}$	effluent discharge rate of wastewater sewer	[L d^{-1}]	2.0 x 10^6
$Clocal_{eff}$	concentration in mixed wastewater	[kg L^{-1}]	

In most cases, $Elocal_{wastewater}$ will be calculated according to the city-scenario endorsed at TM IV-2013 (refer to MOTA chapter 5.2.6, Q1). For PT 9 (polymeres) a use-based approach for the estimation of environmental exposure of roof membranes was developed (refer to the respective document which will be included in MOTA).

$$Clocal_{water} = Clocal_{eff} / ((1 + Kp_{susp} \times SUSP_{water} \times 10^{-6}) \times DILUTION) \quad (2)$$

where:

Kp_{susp}	solids-water partitioning coefficient of suspendet matter	[L kg^{-1}]	TGD eq.23
$SUSP_{water}$	concentration of suspended matter in the river	[mg L^{-1}]	15
DILUTION	dilution factor		10
$Clocal_{water}$	local concentration in surface water	[kg L^{-1}]	

Direct rainwater discharge (separate sewer system)

In separate sewer systems rainwater and wastewater are separately collected in different sewers. After leaching from façades and roofs, the active substances of PT 6.2/6.3, 7 to 10 will be collected in the rainwater sewer. The rainwater is (in most cases) not treated and may be directly discharged to surface water bodies if no rainwater detention reservoir is in between.

Currently no scenario exists which calculates $PEClocal_{surface\ water}$ as a consequence of direct rainwater discharge in urban areas. In case of direct emission due to rainwater discharge it is not possible to use the STP bypass scenario of the EU TGD (2003, see above), because the amount of discharge water is not correct. In the EU TGD (2003) the amount of effluent discharge rate is by default 2000 m^3 per day (200 litres per capita per day for a population of 10,000 inhabitants, equation 34, page 63). This value is supposed to be valid for mixed sewer systems and includes both rain- and wastewater. Statistical data from Germany support this assumption (Table 1). Bearing in mind that rainwater collected in rainwater sewers and directly discharged to surface water is presumably not totally recorded in the data of Table 1, which would increase the amount of total sewage, the value of 200 litres per capita per day seems to be a realistic worst case assumption for mixed sewer systems.

Table 1: Sewage amount treated in German public[a] sewage treatment plants (Statistisches Bundesamt, 2009)

	Unit	1998	2001	2004	2007
Population equivalent connected to STPs[b]	[capita]	122.4×10^6	126.2×10^6	124.0×10^6	124.5×10^6
Total sewage amount	[m^3/year]	9.64×10^9	10.47×10^9	9.41×10^9	10.07×10^9
Wastewater	[m^3/year]	4.91×10^9	5.25×10^9	5.20×10^9	5.21×10^9
Rainwater	[m^3/year]	2.76×10^9	3.04×10^9	2.39×10^9	2.76×10^9
Infiltration water	[m^3/year]	1.98×10^9	2.18×10^9	1.81×10^9	2.10×10^9
Mean daily sewage amount per population equivalent (total)	[L/(capita*d)]	**216**	**227**	**208**	**222**
Mean daily wastewater amount per population equivalent	[L/(capita*d)]	110	114	115	115
Mean daily rainwater amount per population equivalent	[L/(capita*d)]	**62**	**66**	**53**	**61**

[a] Non-public industrial STPs are not considered

[b] The term "Population equivalent" is used to calculate the pollution load, defined as Biochemical Oxygen Demand, produced by one inhabitant per day. It is used to convert the amount of commercial/industrial wastewater, which enters public STPs in a number of inhabitants. Therefore the number of capita includes the inhabitants as well as business and small industry.

As a rough estimate of $Clocal_{surface\ water}$ due to direct rainwater discharge, DE proposes to use in principle the STP bypass scenario of the EU TGD (2003, see above) but to reduce the effluent discharge rate to 600 m^3 per day (60 litres per capita per day for a population of 10,000 inhabitants). Statistical data from Germany show that the mean daily rainwater amount per capita treated in German public STPs is 60 litres (Table 1). Bearing in mind that (a) rainwater collected in rainwater sewers and directly discharged to surface water is presumably not totally recorded in the data of Table 1 and (b) possible infiltration water in the rainwater sewer is neglected, which both would increase the amount of rainwater, a rainwater discharge rate of 600 m^3 per day seems to be a realistic worst case assumption for rainwater sewers.

Scenario "Direct rainwater discharge to surface water in urban areas (separate sewer systems)"

$$Clocal_{rw\_eff} = Elocal_{rainwater} / EFFLUENT_{rainwater} \quad (1)$$

where:

$Elocal_{rainwater}$	daily emission to the rainwater sewer	[kg d^{-1}]	#
$EFFLUENT_{rainwater}$	effluent discharge rate of rainwater sewer	[L d^{-1}]	0.6 x 10^6
$Clocal_{rw\_eff}$	concentration in rainwater	[kg L^{-1}]	

In most cases, $Elocal_{rainwater}$ will be calculated according to the city-scenario endorsed at TM IV-2013 (refer to MOTA chapter 5.2.6, Q1). For PT 9 (polymeres) a use-based approach for the estimation of environmental exposure in case of roof membranes was developed (refer to the respective document which will be included in MOTA).

$$Clocal_{water} = Clocal_{rw\_eff} / ((1 + Kp_{susp} \times SUSP_{water} \times 10^{-6}) \times DILUTION) \quad (2)$$

where:

Kp_{susp}	solids-water partitioning coefficient of suspendet matter	[L kg^{-1}]	TGD eq.23
$SUSP_{water}$	concentration of suspended matter in the river	[mg L^{-1}]	15
DILUTION	dilution factor		10
$Clocal_{water}$	local concentration in surface water	[kg L^{-1}]	

Remark: The assessment of the infiltration of rainwater directly into soil, which is important by default for suburban areas, should be done according to the respective scenarios in the relevant ESDs PT 6 to 10. For PT 9 (polymers) a use-based approach for the estimation of environmental exposure of roof membranes was developed (refer to the respective document which will be included in MOTA).