

# Climate MRV for Africa – Phase 2 Development of National GHG Inventory Industrial Wastewater Treatment



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## Project of the European Commission DG Clima Action

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# Agenda

- Treatment Methods
- Key Industries
- CH<sub>4</sub> Emissions
- Uncertainties

# Treatment Methods

- Discharged to sewer system with domestic wastewater
- Discharged directly into water bodies in some cases
- Major industrial facilities may have comprehensive in-plant treatment
- CH<sub>4</sub> emissions from on-site treatment is estimated in this source category
- If energy recovery is recovered, emissions are reported in energy sector
- Focus on key industries with significant organic loading

# Key Industries

- Pulp and paper
- Alcohol, beer, and starch production
- Organic Chemicals
- Other food and drink processing
  - Dairy products
  - Vegetable oil
  - Fruits and vegetables
  - Canneries
  - Juice making



# CH<sub>4</sub> Emissions

$$CH_4 \text{ Emissions} = \sum_i [ (TOW_i - S_i) EFi - R_i ]$$

Where:

**CH<sub>4</sub> Emissions:** CH<sub>4</sub> emissions in inventory year kg CH<sub>4</sub>/ yr

**TOW<sub>i</sub>:** Total organically degradable material in wastewater from industry in inventory year, kg COD/yr

**i:** Industrial sector

**S<sub>i</sub>:** Organic component removed as sludge in inventory year, kg COD/yr

**EF<sub>i</sub>:** Emission factor for industry i, kg CH<sub>4</sub>/kg COD for treatment/discharge pathway or system(s) used in inventory year If more than one treatment practice is used in an industry this factor would need to be a weighted average.

**R<sub>i</sub>:** Amount of CH<sub>4</sub> recovered in inventory year, kg CH<sub>4</sub>/yr

# CH<sub>4</sub> Emissions

$$EF_j = B_o \cdot MCF_j$$

**Where:**

**EF<sub>j</sub>:** Emission factor, kg CH<sub>4</sub>/ kg BOD

**J:** Each treatment/discharge pathway or system

**B<sub>o</sub>:** Maximum CH<sub>4</sub> producing capacity, kg CH<sub>4</sub> / kg BOD

**MCF<sub>j</sub>:** Methane correction factor (fraction)

**For Egypt B<sub>o</sub> (max methane producing capacity) = 0.25 kgCH<sub>4</sub>/kgCOD**

# CH4 Emissions

$$TOW_i = P_i \cdot W_i \cdot COD_i$$

Where:

**TOW<sub>i</sub>:** Total organics in wastewater in inventory year, kg BOD/ yr

**i:** Industrial sector

**P<sub>i</sub>:** Total industrial product for industrial sector i, t/yr

**W<sub>i</sub>:** Wastewater generated  $m^3/t_{product}$

**COD<sub>i</sub>:** Chemical oxygen demand (industrial degradable organic component in wastewater), kg COD/  $m^3$



# CH4 Emissions

**TABLE 6.9**  
**EXAMPLES OF INDUSTRIAL WASTEWATER DATA**

Industry Type	Wastewater Generation W (m <sup>3</sup> /ton)	Range for W (m <sup>3</sup> /ton)	COD (kg/m <sup>3</sup> )	COD Range (kg/m <sup>3</sup> )
Alcohol Refining	24	16 – 32	11	5 – 22
Beer & Malt	6.3	5.0 – 9.0	2.9	2 – 7
Coffee	NA	NA –	9	3 – 15
Dairy Products	7	3 – 10	2.7	1.5 – 5.2
Fish Processing	NA	8 – 18	2.5	
Meat & Poultry	13	8 – 18	4.1	2 – 7
Organic Chemicals	67	0 – 400	3	0.8 – 5
Petroleum Refineries	0.6	0.3 – 1.2	1.0	0.4 – 1.6
Plastics & Resins	0.6	0.3 – 1.2	3.7	0.8 – 5
Pulp & Paper (combined)	162	85 – 240	9	1 – 15
Soap & Detergents	NA	1.0 – 5.0	NA	0.5 – 1.2
Starch Production	9	4 – 18	10	1.5 – 42
Sugar Refining	NA	4 – 18	3.2	1 – 6
Vegetable Oils	3.1	1.0 – 5.0	NA	0.5 – 1.2
Vegetables, Fruits & Juices	20	7 – 35	5.0	2 – 10
Wine & Vinegar	23	11 – 46	1.5	0.7 – 3.0

Notes: NA = Not Available.  
Source: Doorn *et al.* (1997).



# CH4 Emissions

DEFAULT MCF VALUES FOR INDUSTRIAL WASTEWATER			
Type of treatment and discharge pathway or system	Comments	MCF	Range
<b>Untreated</b>			
Sea, river and lake discharge	Rivers with high organics loadings may turn anaerobic, however this is not considered here.	0.1	0 – 0.2
<b>Treated</b>			
Aerobic treatment plant	Not well managed. Overloaded	0.3	0.2 – 0.4
Anaerobic digester for sludge	CH4 recovery not considered here	0.8	0.8 – 1
Anaerobic shallow lagoon	Depth less than 2 metres, use expert judgment	0.2	0 – 0.3
Anaerobic deep lagoon	Depth more than 2 metres	0.8	0.8 – 1.0

# Uncertainties

DEFAULT UNCERTAINTY RANGES FOR INDUSTRIAL WASTEWATER	
Parameter	Uncertainty Range
Emission Factor	
Maximum CH <sub>4</sub> producing capacity (B <sub>0</sub> )	± 30%
Methane correction factor (MCF)	uncertainty range determined by expert judgment but lies within the range 0 and 1.
Activity Data	
Industrial production (P)	± 25%
Wastewater/unit production (W)	<p>These data can be very uncertain as the same sector might use different waste handling procedures at different plants and in different countries. The product of the parameters (W•COD) is expected to have less uncertainty. An uncertainty value can be attributed directly to kg COD/tonne of product. -50 %, +100% is suggested (i.e., a factor of 2)</p>
COD/unit wastewater (COD)	

# Thank you!

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