Refinement of chapter 5.B.2
Anaerobic digestion at biogas facilities

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TFEIP-meeting Sofia, 26.04.2018
May 2016: TFEIP meeting in Zagreb. Discussion on revised chapter 5.B.2 for EMEP 2016 guidebook:
- Need of improvement for existing revised chapter

August 2016: final version of improved chapter sent to chairs of Ag & N-panel

Mai 2017: TFEIP meeting in Krakow. Discussion of improved chapter 5.B.2
- Further improvement needed to link 5.B.2 to 3.B. and 3.D.
Major changes 2016

- Technology description shortened/restricted to described methodology
- EF were checked and decided to stick to Cuhls et al. (other options not possible within time frame)
- Calculations and EF were transformed to be based on N-mass in feedstock (instead fresh matter)
- Information on N-content of various feedstocks for AD is given in case only fresh matter masses are known.
- Tier 1 method introduced (was missing so far)
- For emission control, reference is given to chapter 3B (storage)
- Clear linkages to chapter 3B (slurries entering AD) and 3D (digestate spreading) introduced.

General structure not changed
Further refinement (for this meeting)

- Improve links to 3.B. for manure and 3.D for energy crops and organic waste
- Add TAN-flow to 5.B.2 for manure
- Account for mineralization of organic N to TAN for manure during digestion
5.B  **Energy crops / Waste material**
Activity data from national statistics transferred into N\text{tot} flow

3.B  **Manures**
N\text{tot} and TAN flow \textit{per animal category}

3.D  **Calculation and reporting of emissions from application**:
- **3Da2a** Livestock manure applied to soils
- **3Da2c** Other organic fertilisers applied to soils

.reporting:
Calculation of emissions in chapter 5.B

- **Tier 1**

  All emissions calculated based on total N in feedstock

  \[ E_{NH3} = AR_{\text{feedstock}} \times EF_{NH3-N, \text{Tier 1}} \times 17/14 \]  

  \[ \text{(1)} \]

  **If Tier 1 is used in 3.B:**

  - Emissions in 3.B. calculated on based on animal places
  - Care needs to be taken to avoid double counting of N excreted by animals!!

  ➡️ No consideration of digestate from manures in 3.B
Calculation of emissions in chapter 5.B

- **Tier 2**

Feedstock N → Pre-storage → digestion → separation

EF 1

EF 2

Storage-liquid

Storage-solid

Storage-not separated

EF 3

EF 4

EF 5 (=EF3+EF4)

EF based on Cuhls et al.

All emissions calculated based on total N in feedstock

\[
E_{NH3} = AR_{feedstock} \times \sum_{\text{stages}} EF_{NH3-N, \text{stage i}} \times 17/14
\]  

(2)
Calculation of N in digestate after storage

For energy crops and waste

\[ N_{\text{tot,dig}} = N_{\text{tot,sub}} - (E_{\text{NH3}} \times 14/17) \]  

(3)

with:

- \( N_{\text{tot,dig}} \): N\text{tot} in digestate after storage in kg a\(^{-1}\)
- \( N_{\text{tot,sub}} \): N\text{tot} of the feedstock entering 5.B.2 in kg a\(^{-1}\)
- \( E_{\text{NH3}} \): NH\(_3\) emitted in kg a\(^{-1}\), calculated in equation (1) or (2)

For manures

\[ TAN_{\text{dig}} = TAN_{\text{sub}} + f_{\text{min}} \times (N_{\text{tot}} - TAN_{\text{sub}}) - (E_{\text{NH3}} \times 14/17) \]  

(4)

with

- \( TAN_{\text{dig}} \): TAN in digestate after storage in kg a\(^{-1}\)
- \( TAN_{\text{sub}} \): TAN in manure entering 5.B.2 in kg a\(^{-1}\)
- \( f_{\text{min}} \): relative share of organic N entering the digester that is mineralized to TAN in kg kg\(^{-1}\)
- \( E_{\text{NH3}} \): NH\(_3\) emitted in kg a\(^{-1}\), calculated from total N in equation (2)

- Germany: Survey showed, that mean TAN in digestion of manure rises from 45% to 62%

\[ f_{\text{min}} = 0.32 \]
Further steps

- Thorough review on emission factors (now: only based on one study)
  - If possible: TAN for every step based rather than based on Ntot in feedstock

- Discussion needed on:
  - Consideration of separation
  - Use of digestates for other purposes than agriculture (fertilization)

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