Brown paper wastewater as a source of biogas – aims, challenges and added value

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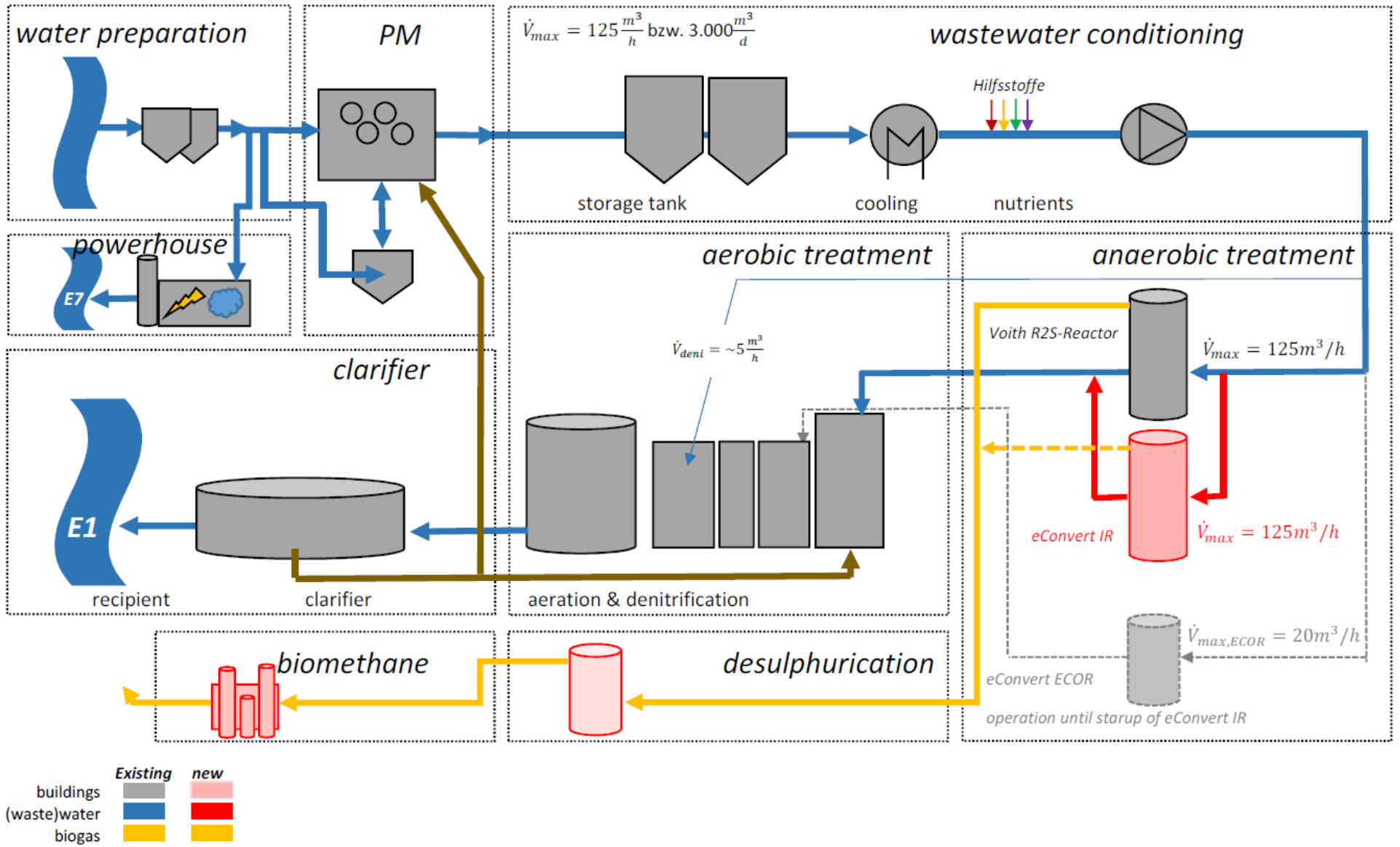
JULIUS SCHULTE TREBSEN GMBH & CO. KG

Julius Schulte Trebsen GmbH & Co. KG

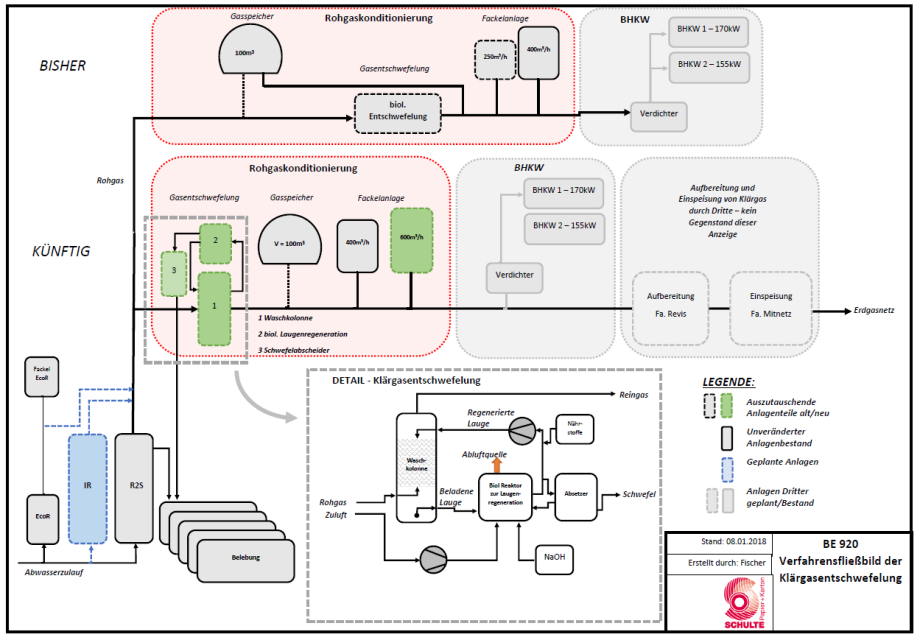
- Est. 1893 in Trebsen/Mulde, independent company
- Currently ~130 employees
- 24/7 operation in a 5-shift-system throughout 365 d/y
- Production of approx. 240.000 t/y of liners, flutings and specialities from 100 % recovered paper
- 1 paper machine with a machine width up to 4.300 mm
- Grammages ranging from 120 to 280 g/m²
- Share of export approx. 70 %
- Own powerhouse with ~8MWel and 60 t Steam/h
- Biological two-stage wastewater treatment plant

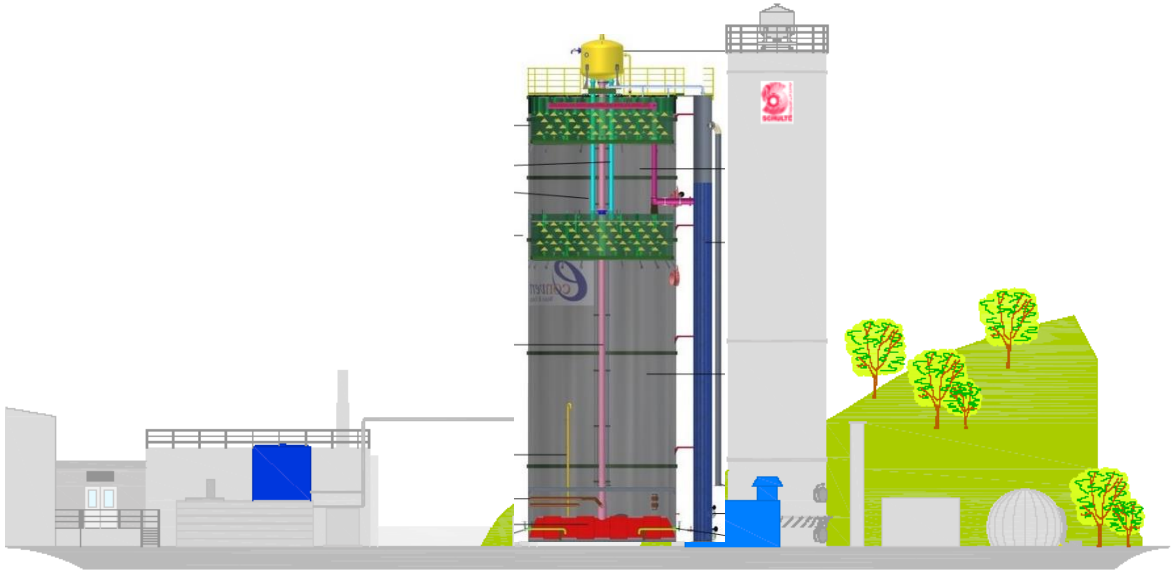
Block diagram of the water cycle



Basic concept

- Anaerobic stage consists of two internal recirculation reactors
  - Voith R2S for 22,5t_{COD}/d
  - eConvert IR for 30t_{COD}/d
- Aerobic stage consists of 4+1 basins in a line and a final clarifier
  - Major part of degradation takes place in basin 1 &2
- Biogas from anaerobic stage to be treated in a conditioning line
  - 70% methane
  - up to ~14,000m³/d



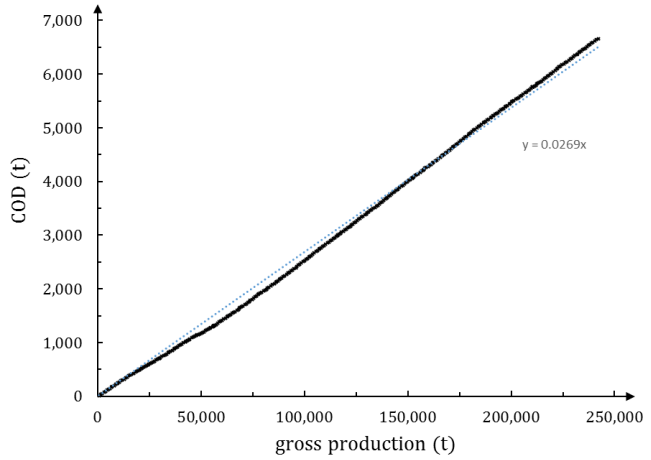


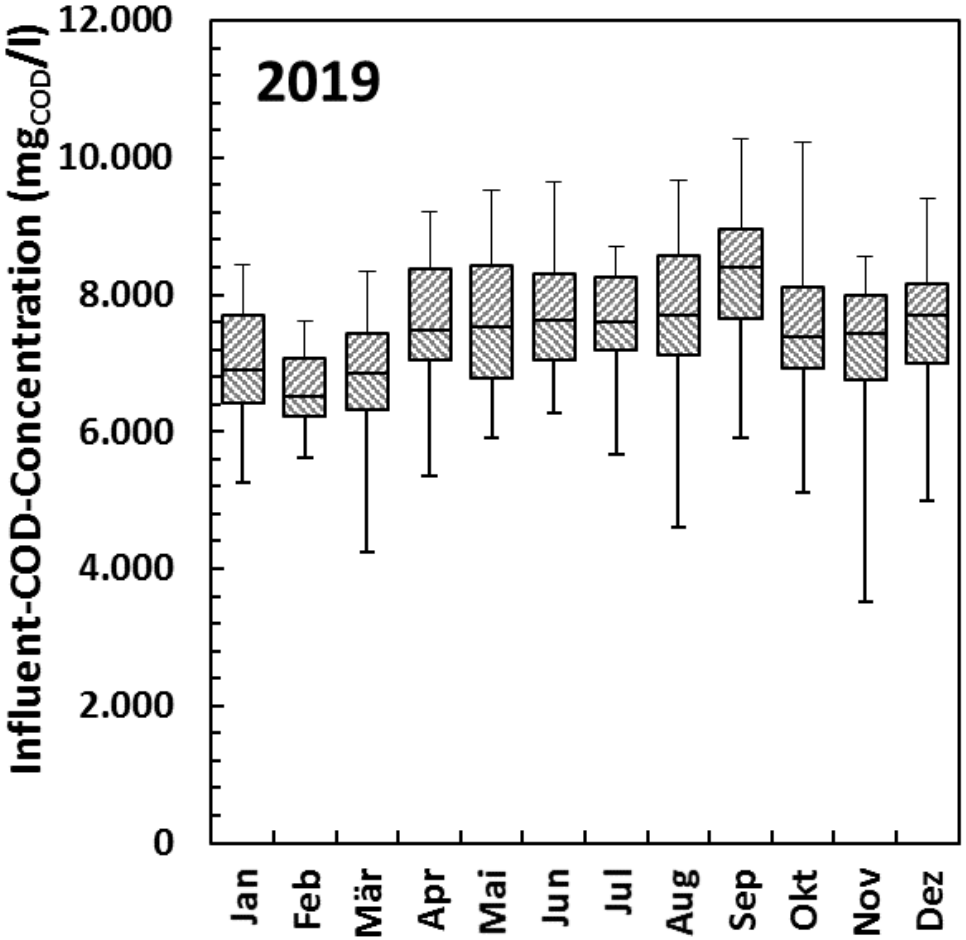
Two-stage industrial wastewater treatment concept (anaerobic/aerobic)

- COD of effluent from paper mill ranges between 6,000 and 9,000mg/l →conventional aerobic treatment is limited to max. 2,000mg/l
- Anaerobic first stage offers advantages
  - Easy to degrade components, mainly starch and organic acids from its decomposition
  - effective Reduction of COD by >80%, BOD by >>80%
  - HRT ranging between 6-12h
  - good mass balance due to low biomass production → COD-load of up to 22t/d would create huge amounts of sludge if treated aerobically
  - water temperature from paper mill allows operation without additional heating
- Aerobic second stage is still needed to meet regulatory water quality parameters [COD (TOC),BOD, N (Tnb), P]

Design parameters and technology - influent

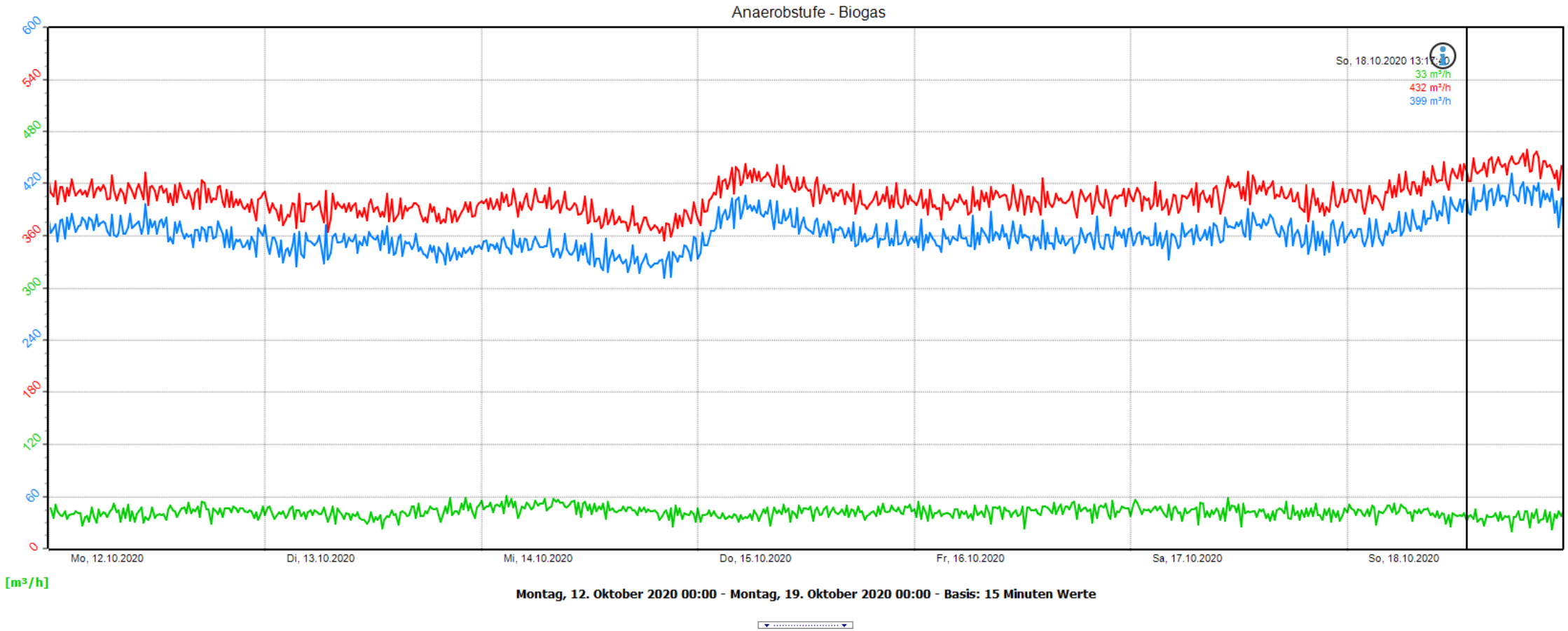
- 1t of paper leads to 0.025-0.035kg of COD, average ~0.027t_{COD}/t
- 1t of COD yields 350m³ of methane theoretically
- biogas production rate is variable and quickly changing, also seasonal changes can be observed
- biogas contains between 5,000 and 8,000ppm of H_2S and even more if pH of reactor is lowered





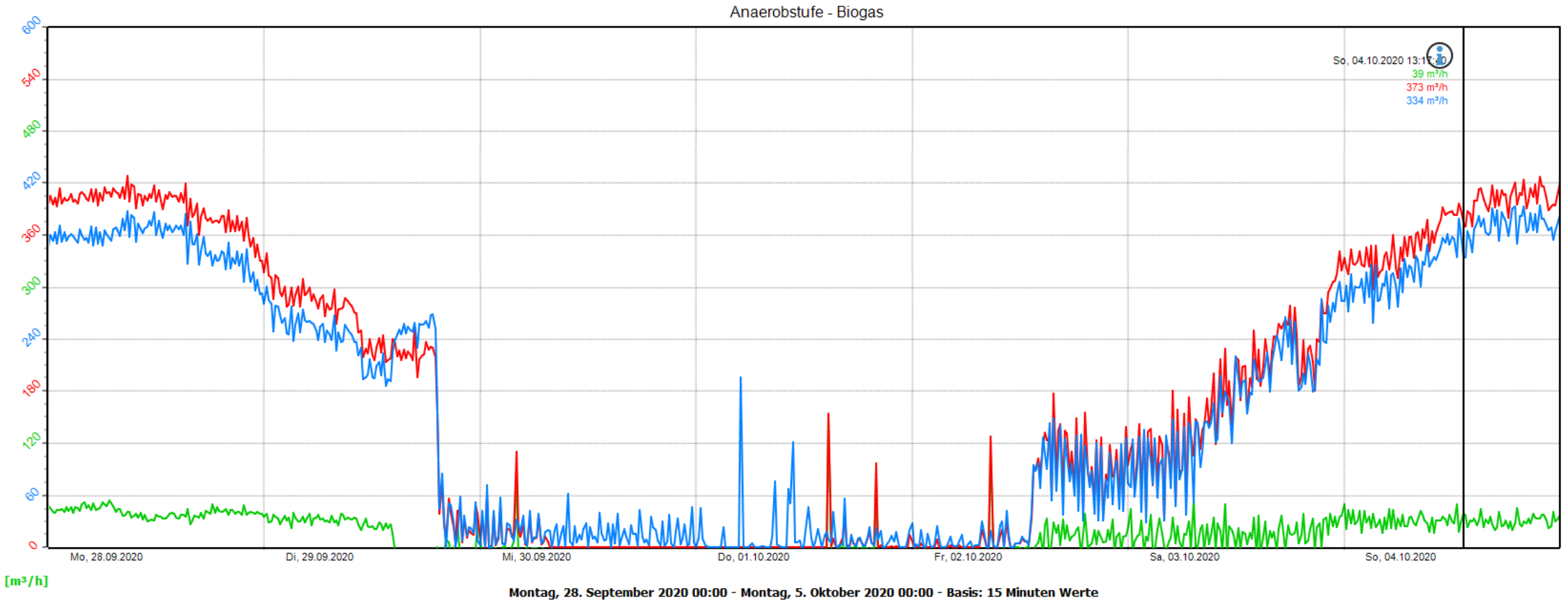
Operational aspects – biogas production

Best case: constant production of biogas



Operational aspects – biogas production

Maintenance week: planned stop and smart restart



Operational aspects – reconstruction of biogas treatment

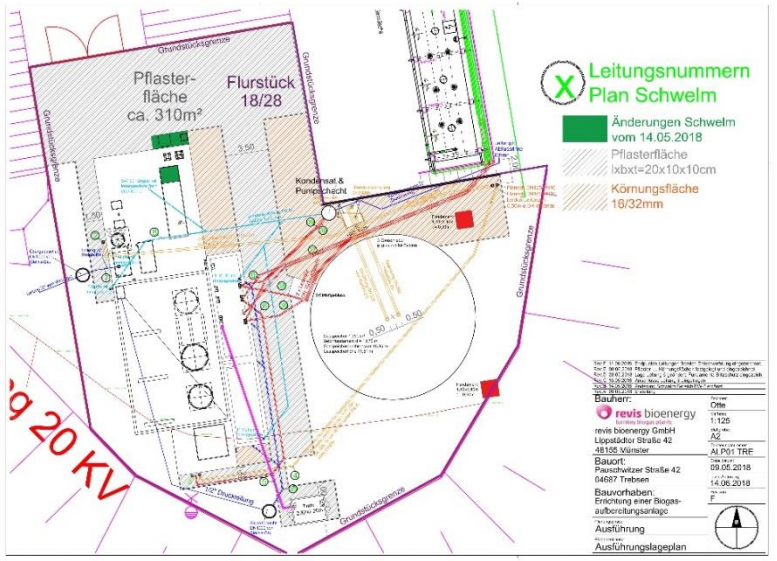
Stable removal sulphur is quite challenging

- biological biogas treatment until 10/2019
  - Easy to operate system
  - stable biology
  - low operating costs but high maintenance costs (clogging)
  - share of oxygen and inert gases in biomethane often critical
  - Oxygen concentrators are sensitive in different ways
  - Activated charcoal from uprgrading plant needed to be replaced in rapid succession
- Thiopaq process since 10/2019
  - combines chemical and biological treatment
  - relatively high operational costs for sodium hydroxide
  - Degradation from 8,000 ppm H2S down to <<150 ppm but sensitive to process changes
  - Share of methane increased from ~65 to ~69%, abscence of inert gases
  - No activated charcoal removal in the last year required

Design parameters and technology – Biogas Trebsen GmbH

Source: RAPIS Sachsen

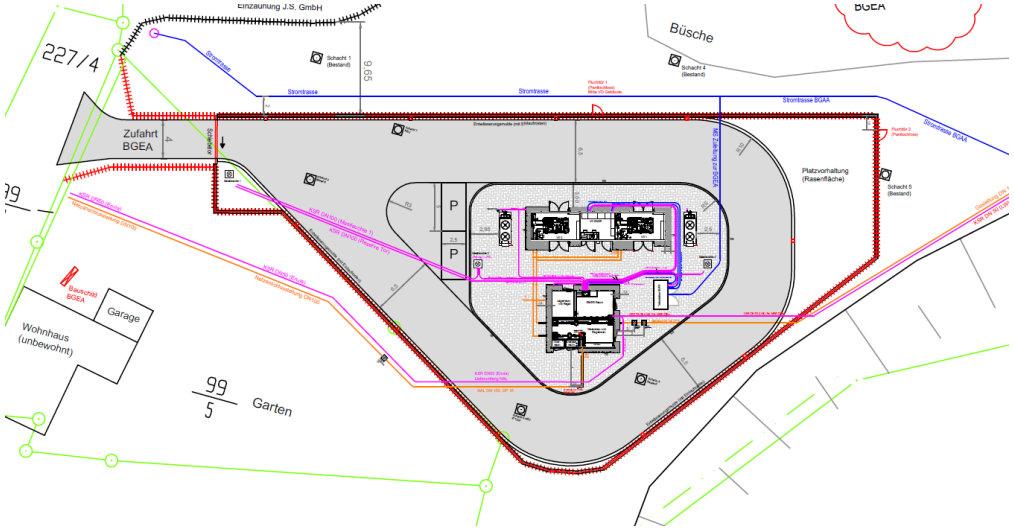
- Biogas upgrading plant with 550 Nm³/h biomethane
- Upgrading of the biogas from the anaerobic process water treatment of a paper mill (Julius Schulte Trebsen GmbH & Co. KG)
- Planning, plant construction, gas processing as well as operation of biogas by revis bioenergy
- Construction time 6 months, Operation of plant since December 2018



Design parameters and technology – Biogas Trebsen GmbH

- No system staff on site, technical & commercial management is taken over by revis bioenergy and Biogas Gommern (biogas plant near Magdeburg)
- Investment amount: approx. € 4 million
- Biomethane treatment process: physical absorption
- Handover of the processed gas to the MITNETZ feed-in station, built approx. at 200m from upgrading plant

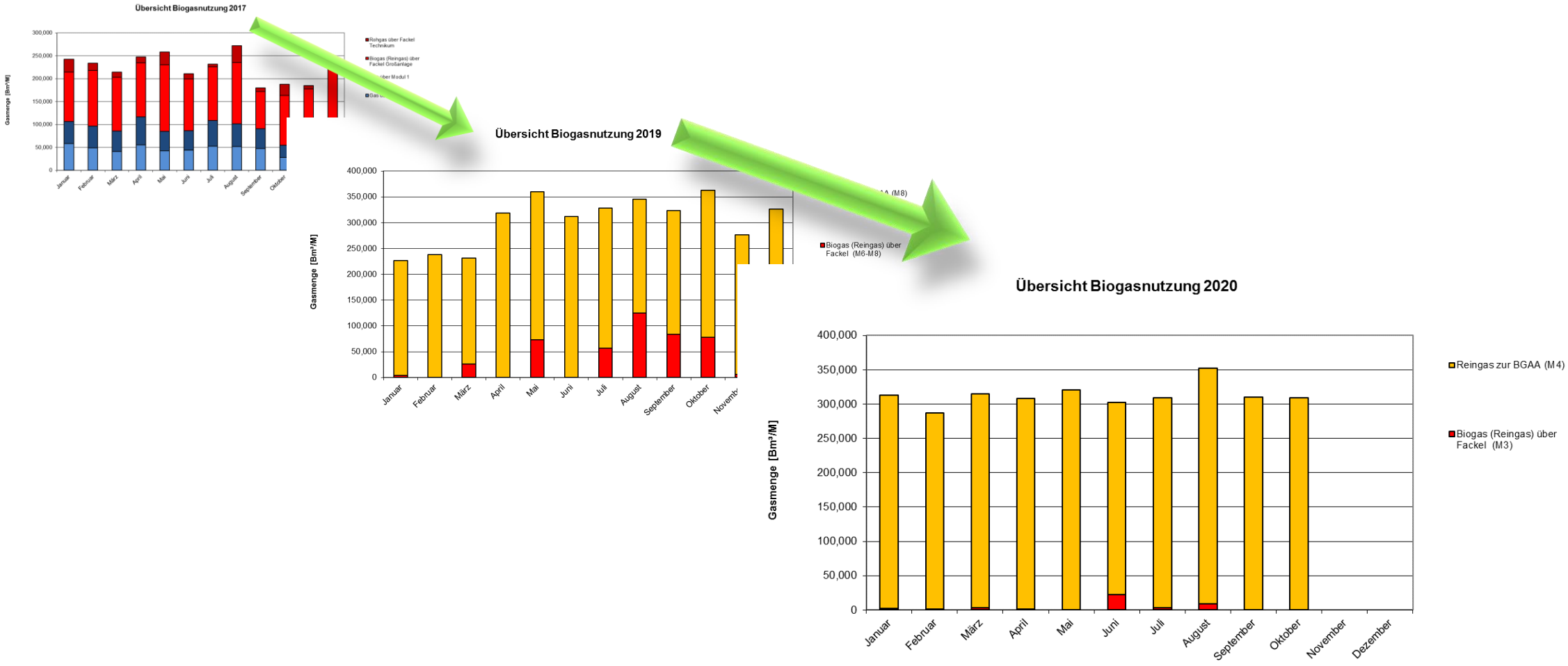
Source: revis bioenergy



Source: epeg/MITNETZ Gas GmbH

Source: RAPIS Sachsen

Operational aspects – biogas utilisation



Summary

- Successful start-up and operation since 12/2018 – stepwise increase of biogas feed-in and less downtime in 2019 – 2020
- Biogas is a side-product and not considered in terms of paper production matters
- Flexible plant design - production of biogas might vary by 50% in a short period
- H2S was the main issue regarding gas quality (direct and indirect)
- Operational costs seem to shift from maintenance to chemicals
- biological biogas treatment using oxygen generators can not be recommended
- Operation of gas flare is limited to maintenance (and very few events)
- in terms of the legal definition of biogas from paper the situation is complex

Thank you for your attention!

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