Process control and process stability at the Vestby WWP, Norway (Real Time Demo)

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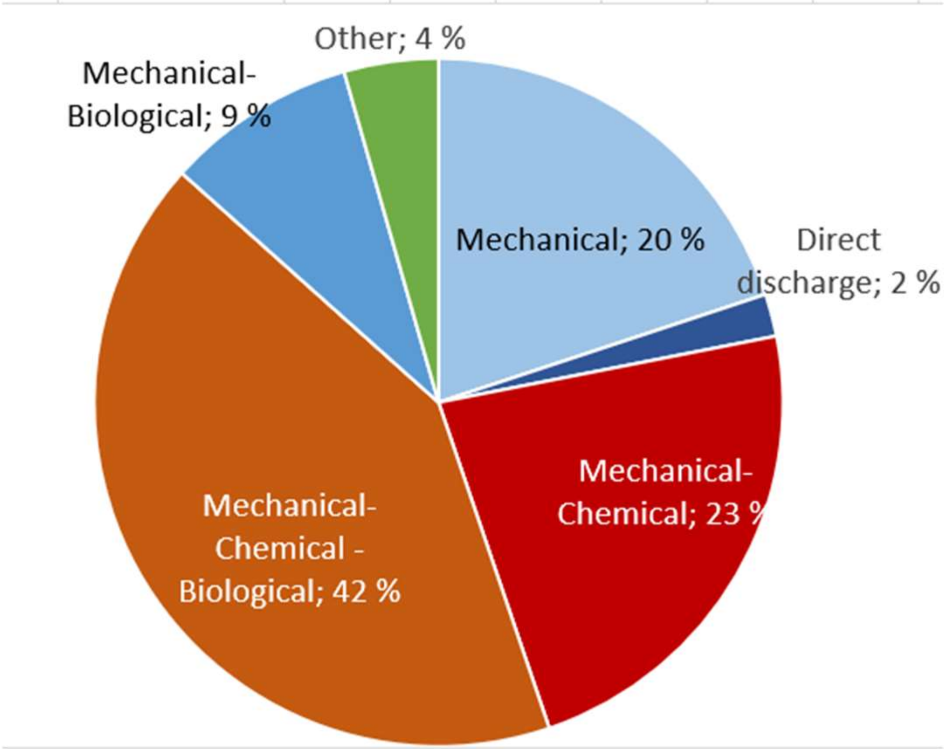
Coagulation- still common in wastewater treatment

- 2/3 of wastewater in Norway is treated chemically or chemical-biologically
- 23% of the population – still connected to WWTPs with coagulation only
- Majority of these plants are now required to adhere to secondary treatment requirements in UWWD



Secondary treatment requirement

- BOF_5 treatment efficiency > 70% <u>or</u> effluent concentration < 25 mg O_2 /l <u>og</u>
- KOF_{CR} treatment efficiency >75% <u>or</u> effluent concentration < 125 mg O_2 /l

Additionally, two requirements:

- Max 3 of 24 samples are allowed to exceed the required conditions
- No sample may exceed the concentration requirement by 100%..

From 86 Norwegian WWTPs	Effluent, mg/l	Treatment efficiency
BOF7	28 ± 13,5	80,6 ± 10,6
KOF	103 ± 37	74,7 ± 7,7

Ødegaard, 1990

Nøkkeltall utslipp	Krav	2018	2019
Total-P, utløp, mg/l		0,5	0,37
Total-P, renseeffekt %	90	91	91
KOF, utløp, mg/l	125	145	89
KOF, renseeffekt %	75	77	74
BOF, utløp, mg/l	25	69,2	28,5
BOF, renseeffekt %	70	74	75
Krav til sekundærrensing overholdt		Nei	Nei

Many WWTPs do not satisfy the secondary treatment requirements

- What options are available?
  - Add a biological step – the most common way of thinking All Q or part?
  - Super-optimisation of the coagulation
  - Super optimisation of coagulation combined with oxidation methods

If and when needed?
All Q or part?

- How much COD and BOD can be removed with super-optimised coagulation? DOSCON AS
- Which «on & off» concepts can be used to reduce COD/BOD peaks? Oxidation, NMBU
- Is it possible to reduce COD/BOD peaks with an MBBR for side stream? SET AS /Ødegaard

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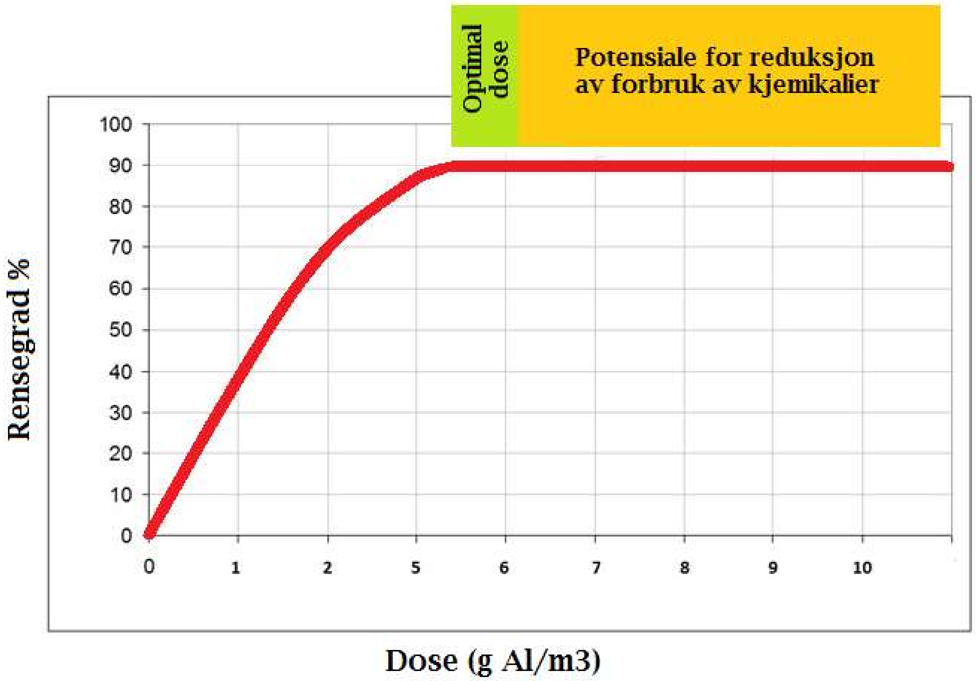
How to optimise a coagulation plant for COD removal



DOSCON uses several water quality parameters to define the optimal dosage in real-time

First installation was in 2009: NRA-Lillestrøm; still saving >30% chemically

Green: Optimal dosage

Yellow: Good treatment efficiency but overdosage

Dosing control stratgy

Original algorithm

$$Dose = f(Q, pH_{in}, Cond_{in}, SS_{in}, ORP_{in}, SS_{out}, T_{in}, PHO_{out})$$

Improved algorithm

$$Dose = f_1(Q, pH_{in}, Cond_{in}, SS_{in}, ORP_{in}, SS_{out}, T_{in}, PHO_{out})$$

$$+ f_2(TP_{inlet}, COD_{inlet}, COD_{inlet})$$

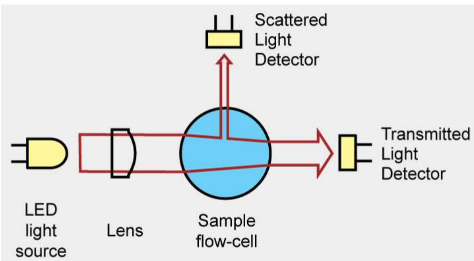
Hybrid sensor

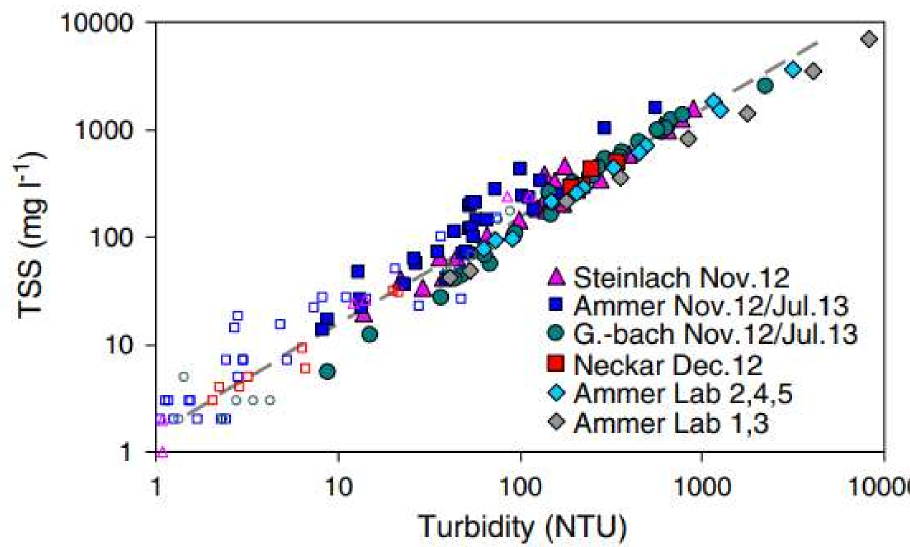
$$+ f_3(TP_{forecast}, OP_{forecast}, COD_{forecast})$$

Prognosis of treatment efficinecy

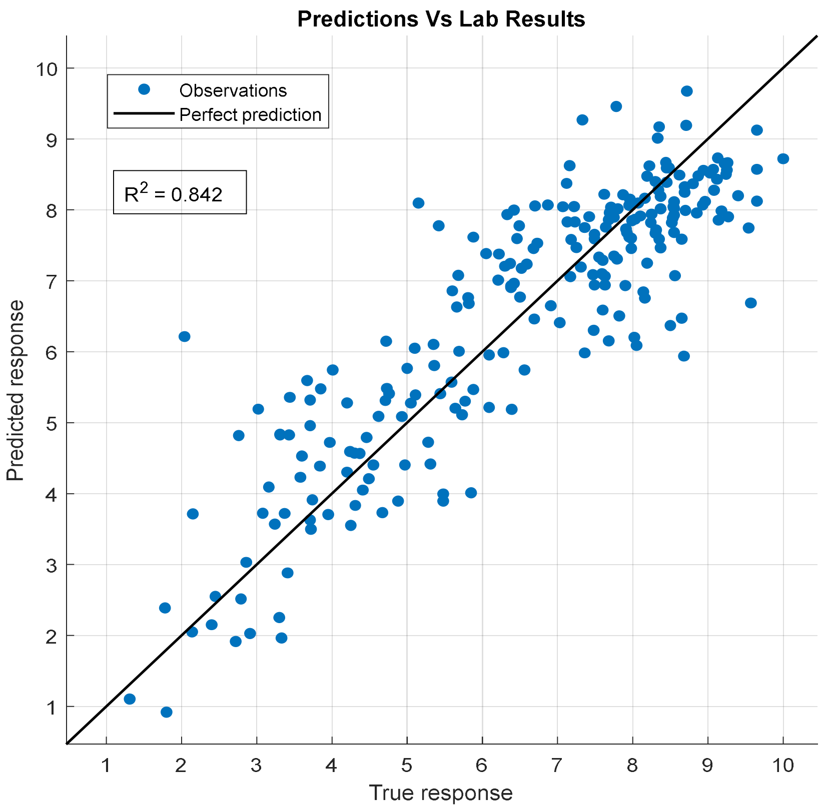
Hybrid sensor

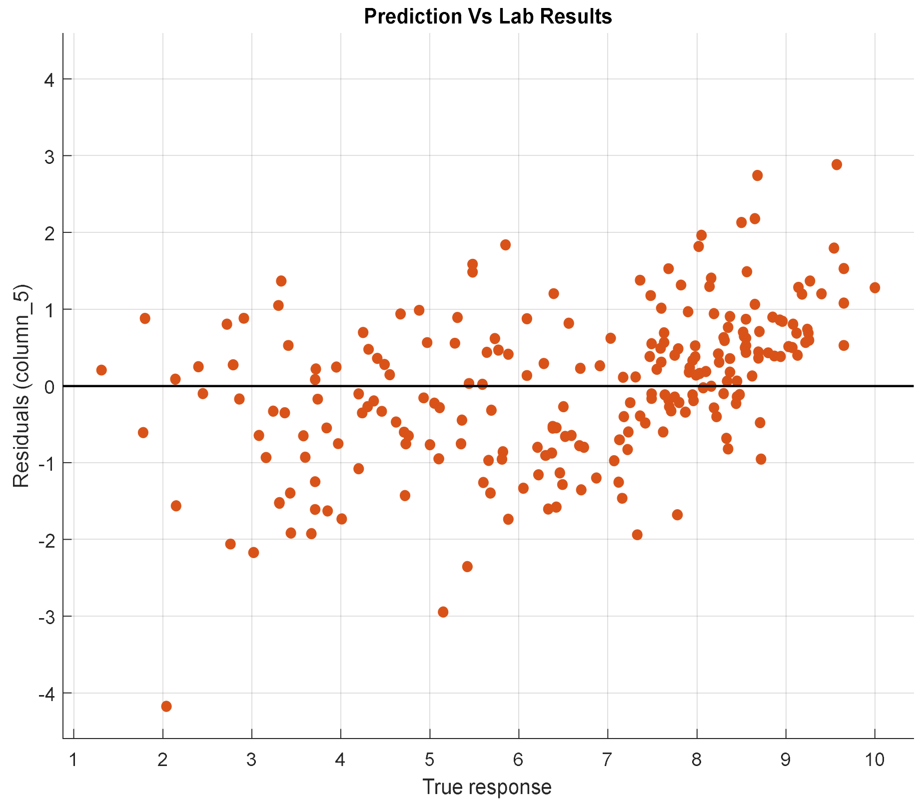
Typical example: Measurement of SS via turbidity



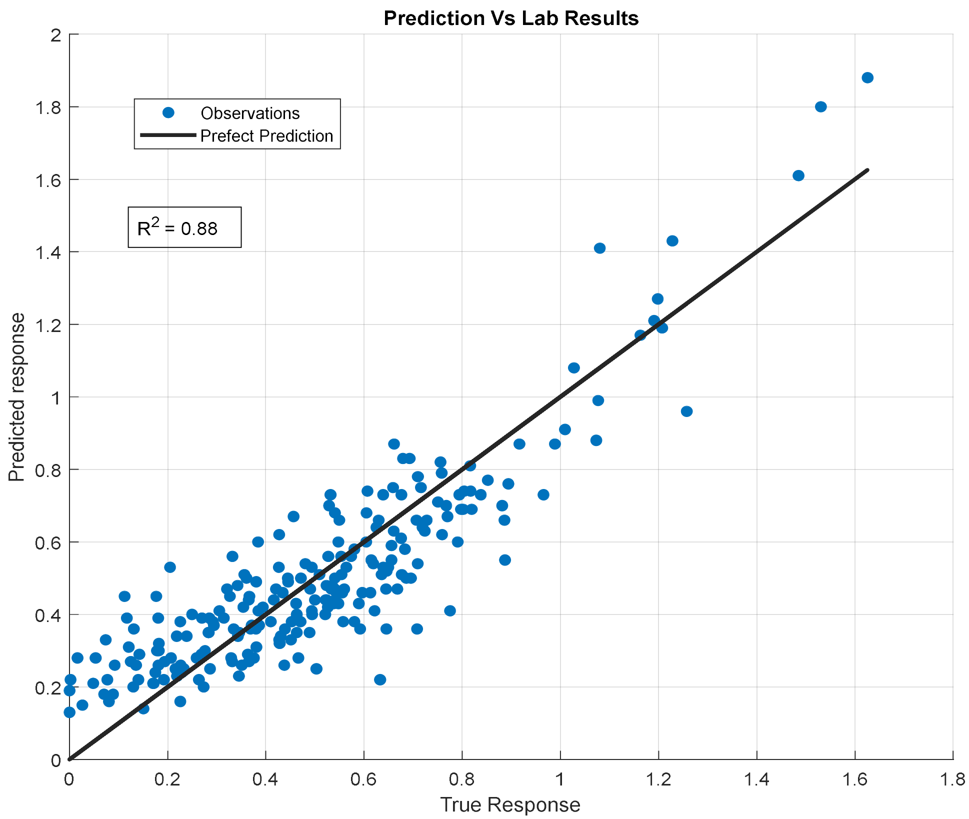


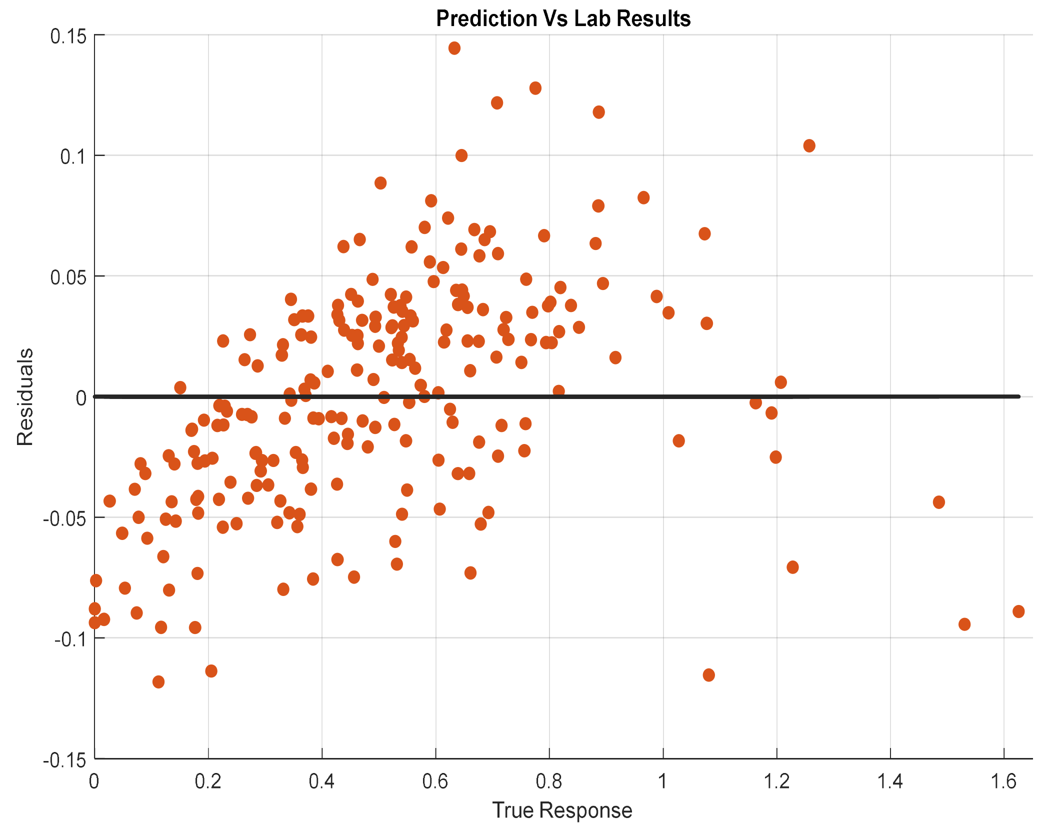
Virtuell sensor for Total P ved innløp (SFR-Vestby)





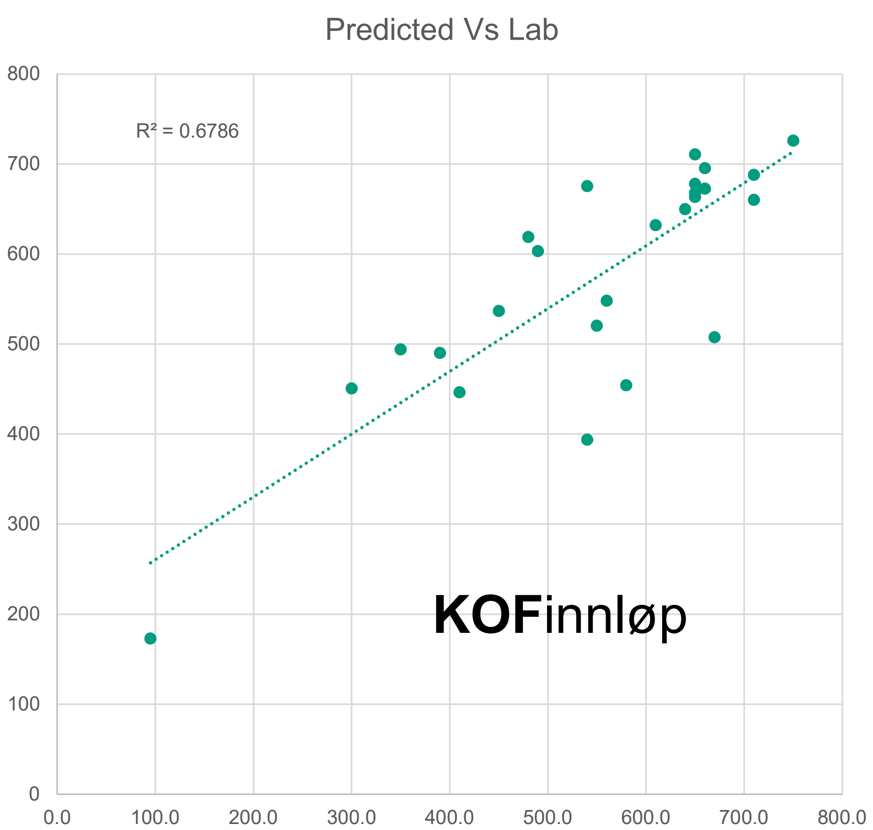
Virtuell sensor for Total P ved utløp (SFR-Vestby)

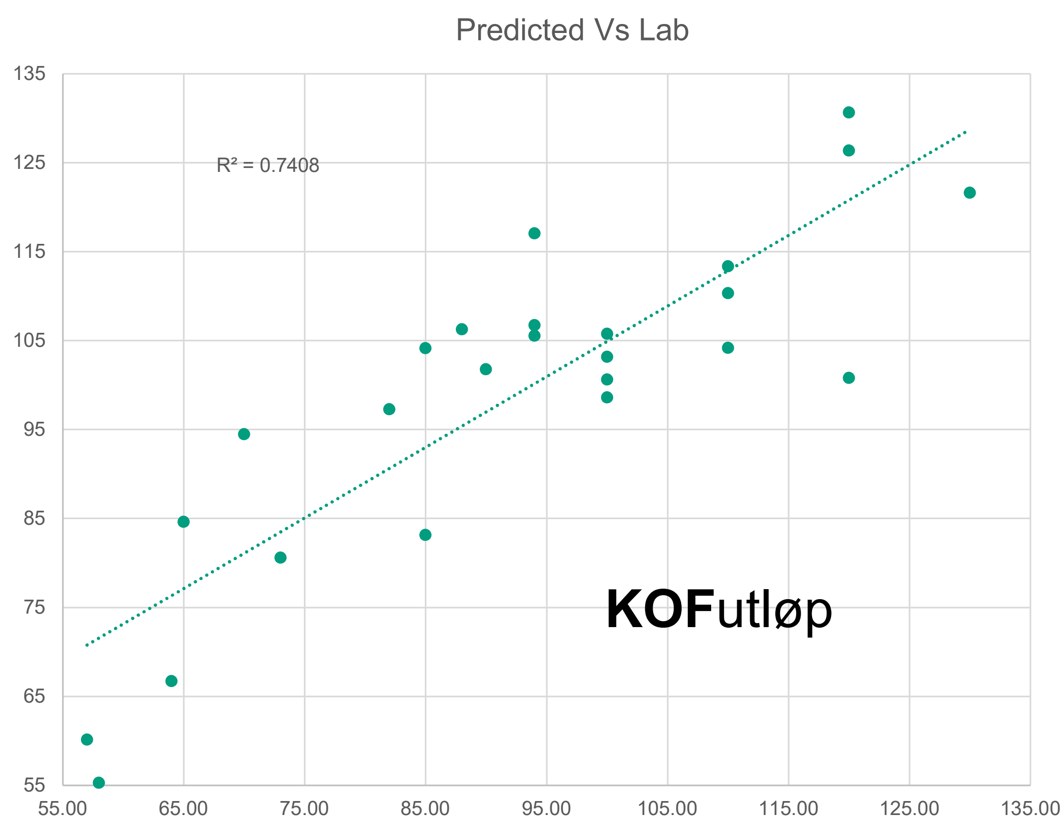




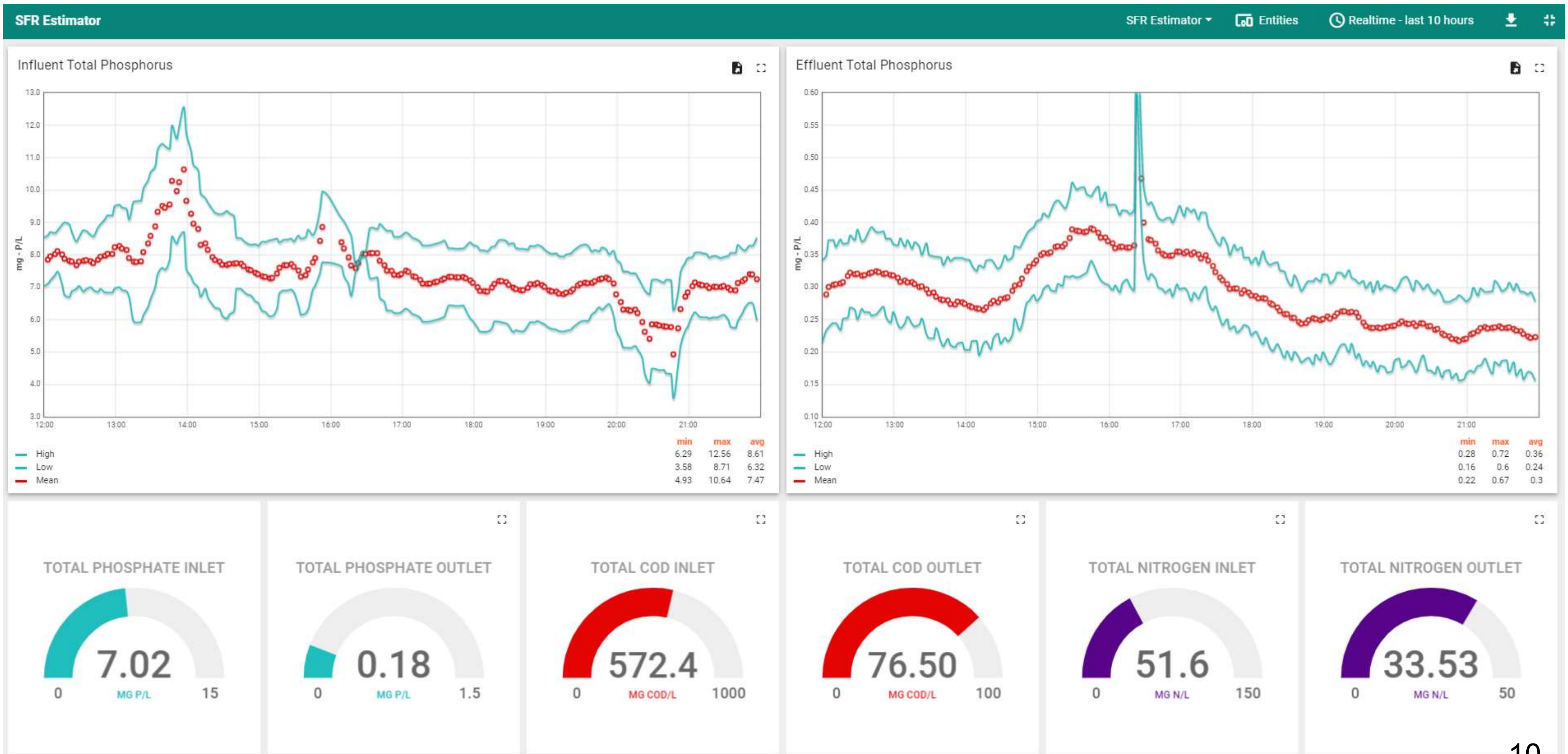
Virtuell sensor for KOF ved innløp/utløp (SFR-Vestby)

DOSMON

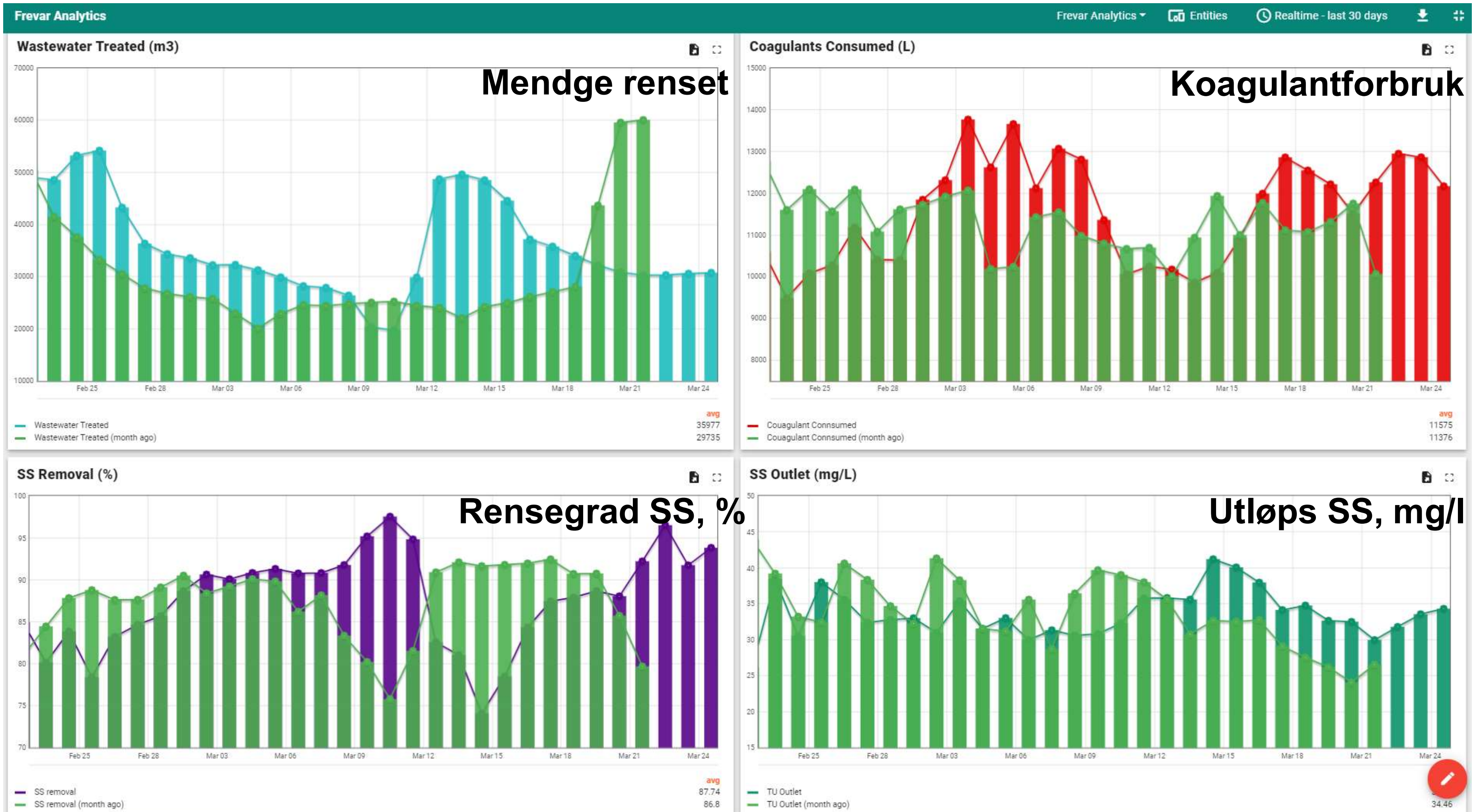




Virtuelle sensorer

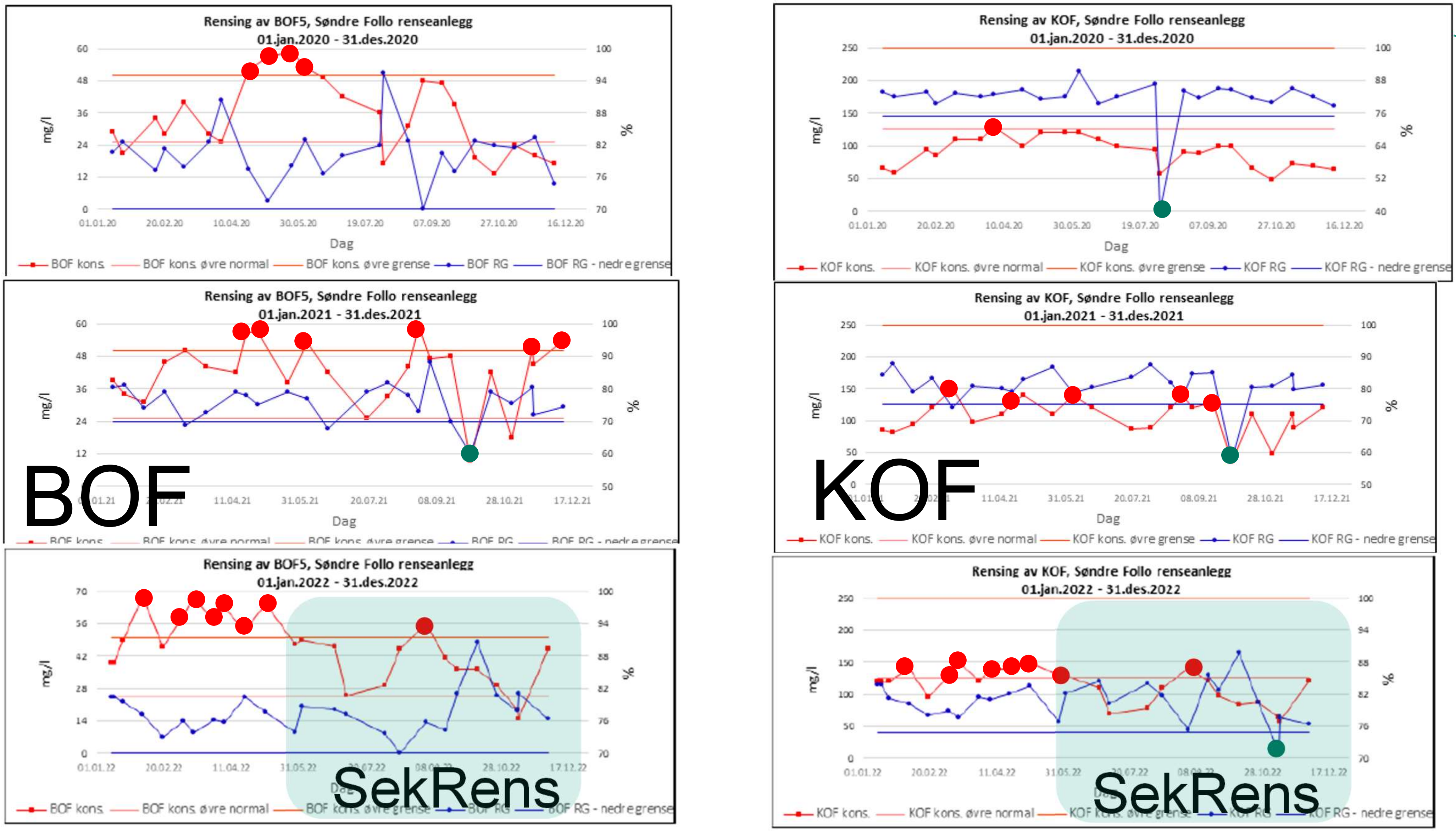


Oppsummering av driftsresultater



Results with super-optimal coagulation

Nøkkeltall utslipp	Krav	2018	2019	2020	2021	2022
Total-P, utløp, mg/l		0,5	0,37	0,23	0,54	0,58
Total-P, renseeffekt %	90	91	91	95	93	93
KOF, utløp, mg/l	125	145	89	90	107	113
KOF, renseeffekt %	75	77	74	83	82	81
BOF, utløp, mg/l	25	69,2	28,5	34,5	42	45
BOF, renseeffekt %	70	74	75	81	77	78
Krav til sekundærrensing overholdt		Nei	Nei	Ja	Ja	Ja


Rensing av BOF5, Søndre Follo renseanlegg
01.jan.2020 - 31.des.2020
mg/l
%
Dag
BOF kons.
BOF kons. øvre normal
BOF kons. øvre grense
BOF RG
BOF RG - nedre grense
Rensing av KOF, Søndre Follo renseanlegg
01.jan.2020 - 31.des.2020
KOF kons.
KOF kons. øvre normal
KOF kons. øvre grense
KOF RG
KOF RG - nedre grense
Rensing av BOF5, Søndre Follo renseanlegg
01.jan.2021 - 31.des.2021
Rensing av KOF, Søndre Follo renseanlegg
01.jan.2021 - 31.des.2021
BOF
KOF
Rensing av BOF5, Søndre Follo renseanlegg
01.jan.2022 - 31.des.2022
Rensing av KOF, Søndre Follo renseanlegg
01.jan.2022 - 31.des.2022
SekRens
SekRens