University College Dublin
Ireland's Global University

Recycle and reuse of dewatered alum sludge in green bio-sorption reactor (GBR) for wastewater treatment: Impacts on suspended slduge

Presented by

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Alum sludge

“ ***Alum sludge*** is the wastewater treatment residue

when ***aluminum salts*** is used as coagulant ”

Adsorption

Water treatment processes

After dewatering

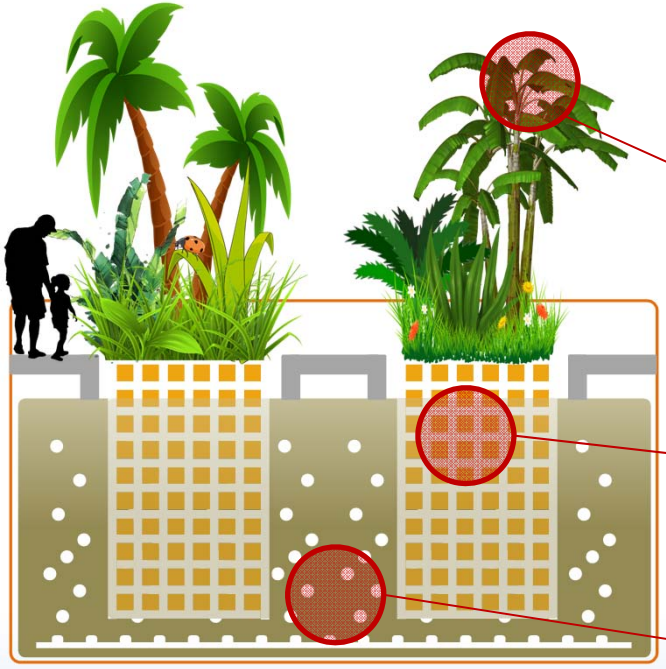
Alum sludge landfilling

Alum sludge constructed wetland (AlCW)

Green bio-sorption reactor (GBR)

“ Embedding *Alum sludge based constructed wetland*

into *conventional activated sludge* ”



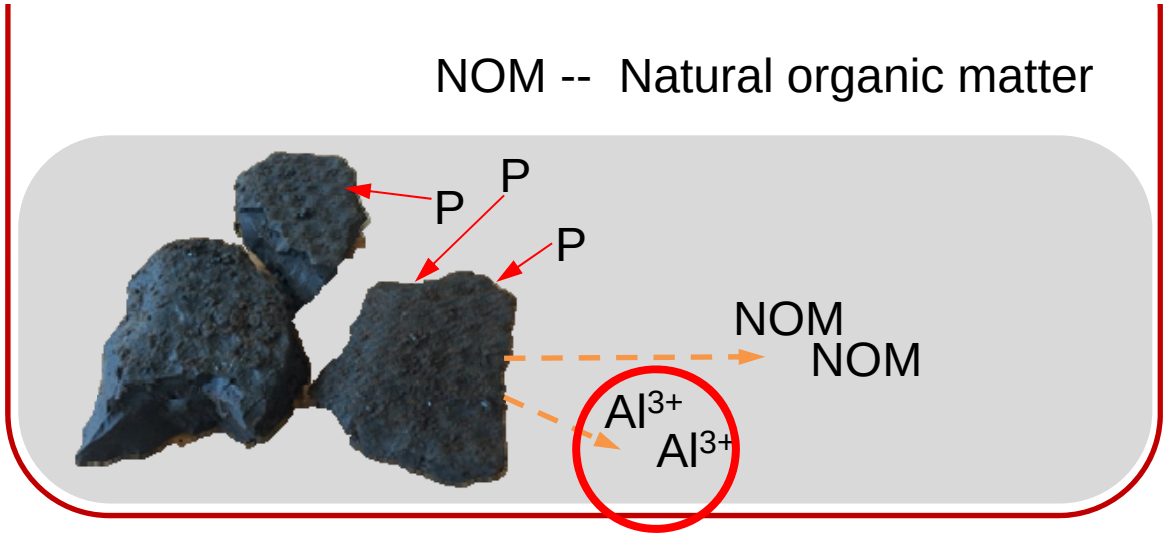
Fantastically aesthetic value
Carbon sink

Carriers to accommodate bacteria
Adsorbents to adsorb P

High treatment capacity

Concerns

“ ***Alum sludge is the agglomeration of Al3+, natural organic matter and other substances*** ”



Purpose

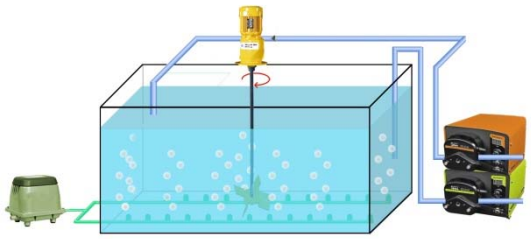
The present study was to

“ 1. investigate the *Al^{3+} release* from alum sludge”

“ 2. and its impacts on the suspended sludge’s activity and properties ”

Materials and methods

SBR



1~6th month (1~186th day)

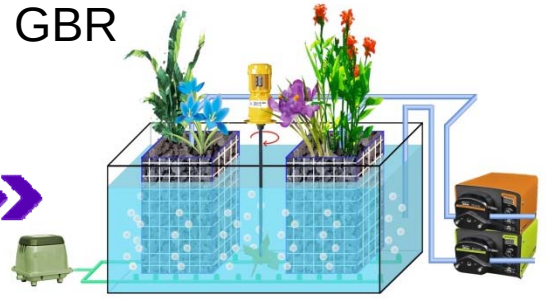
3 cycles/day:
0.5 h FILL
0.5 h anaerobic/3.5 h areobic/1.5 h anoxic REACT
1 h SETTLE
1 h DRAW (& WASTE)

Performance:
94±1.5% COD;
92±4.5% TN;
89±14.5% P.

Capacity:
1.6 kg/(m³·d)

Artificial wastewater:
400 mg COD/L 30-70 mg NH_4^+-N/L 10 mg P/L

GBR



7~14th month (187~456th day)

4 cycles/day:
0.5 h FILL
3.5 h areobic/0.5 h anoxic REACT
1 h SETTLE
0.5 h DRAW (& WASTE)

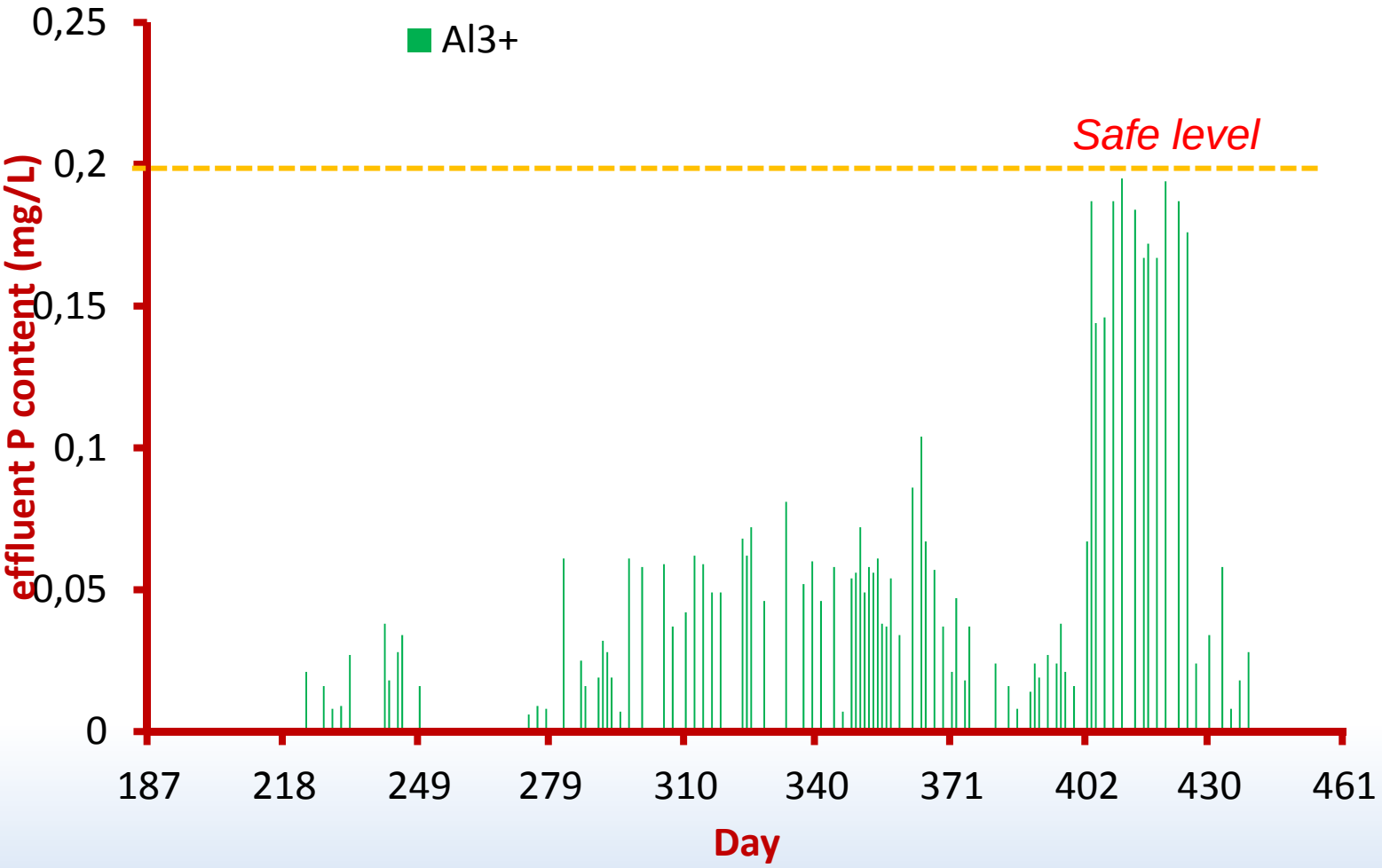
Performance:
90±5% COD;
89±6.2% TN;
93±3.5% P.

Capacity:
2.1 kg/(m³·d)

Artificial wastewater:
400 mg COD/L 70-90 mg NH_4^+-N/L 10 mg P/L

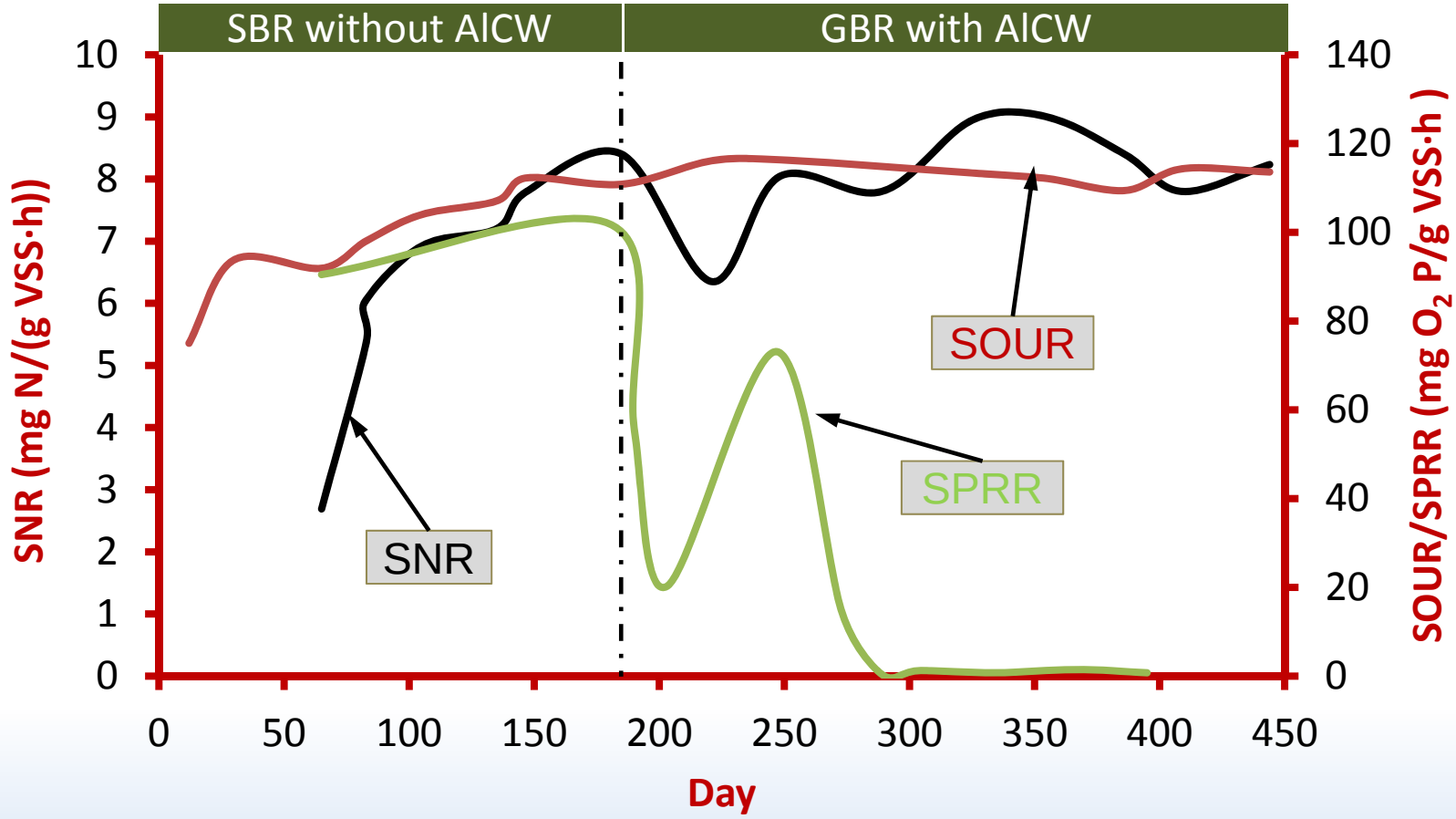
The Al3+ release and the sludge's properties were monitored regularly.

Al^{3+} release


Al3+
Safe level
effluent P content (mg/L)
0,25
0,2
0,15
0,1
0,05
0
187
218
249
279
310
340
371
402
430
461
Day

“ Al^{3+} release is ***not a big concern*** ”

Inhibition on bacteria



SNR – specific nitrification rate

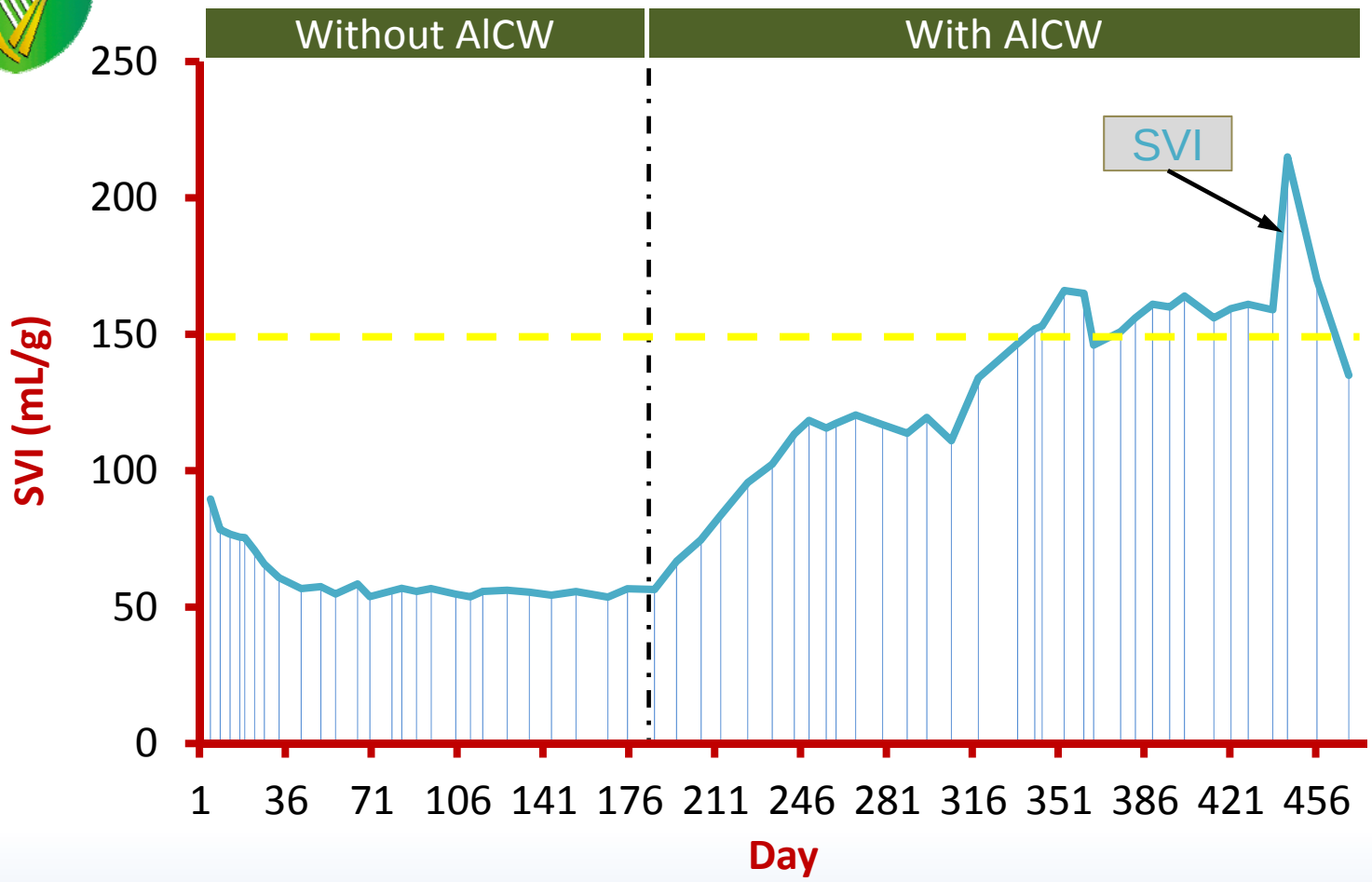
SPRR– specific phosphorus release rate

SOUR – specific oxygen uptake rate

“ Alum sludge was ***not an inhibition on*** nitrifiers and heterotrophy

but ***depressed*** the activity of ***PAOs*** ”

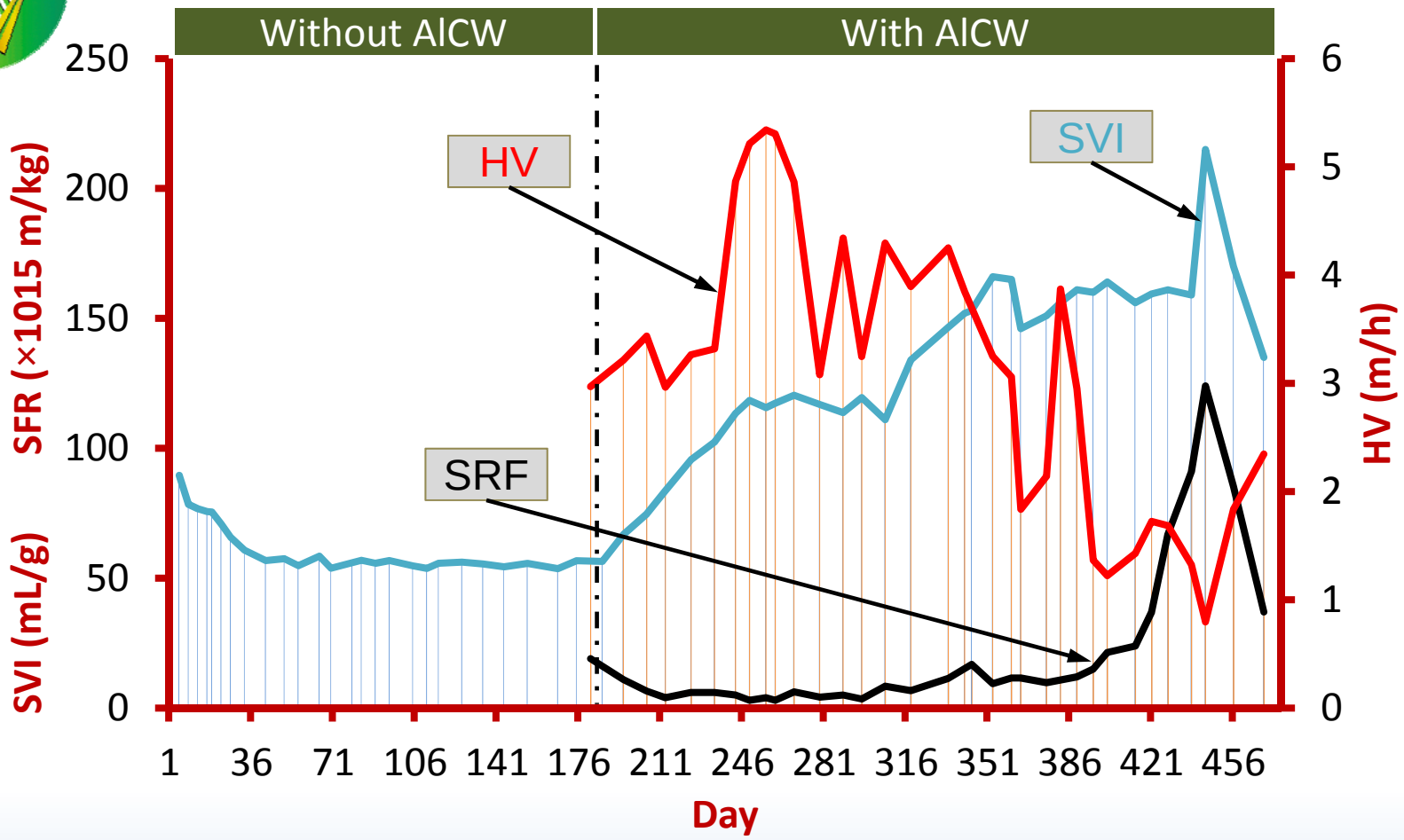
Sludge properties



Compressibility

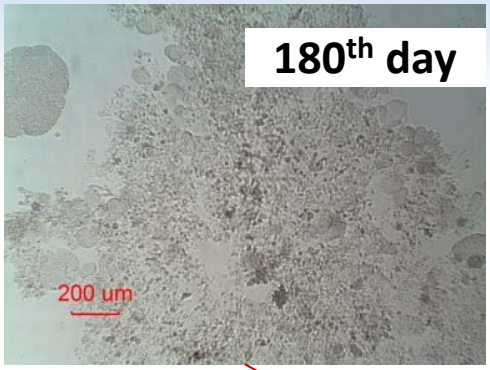
SVI – sludge volume index HV – hindered settling velocity

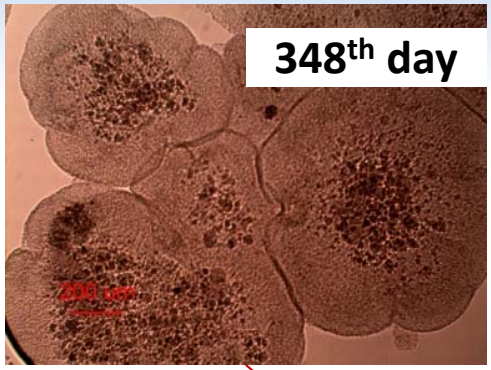
Sludge properties



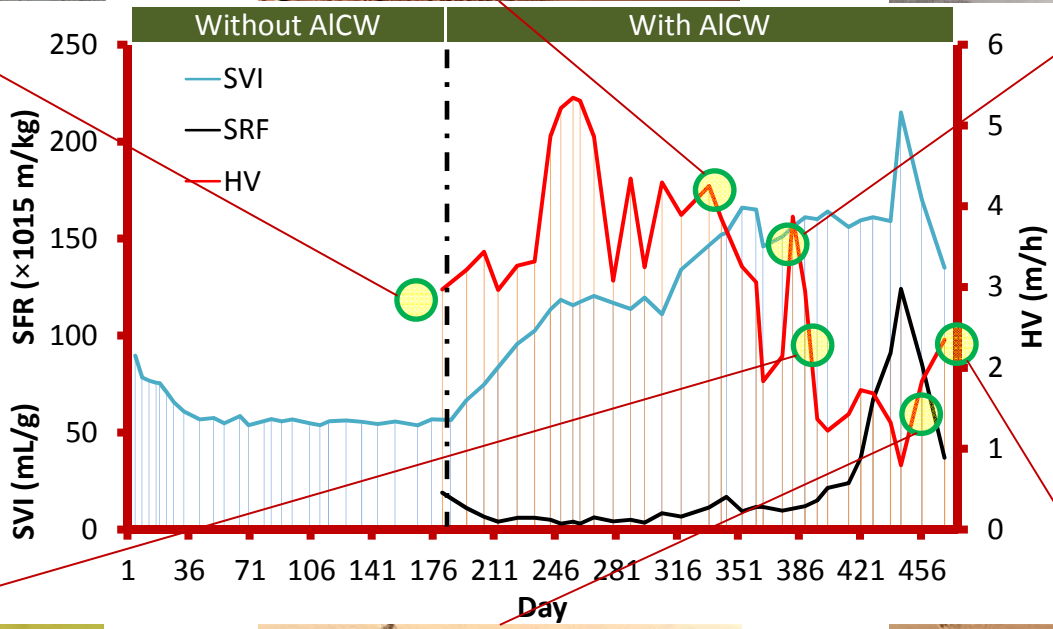
Compressibility, settleability and dewaterability

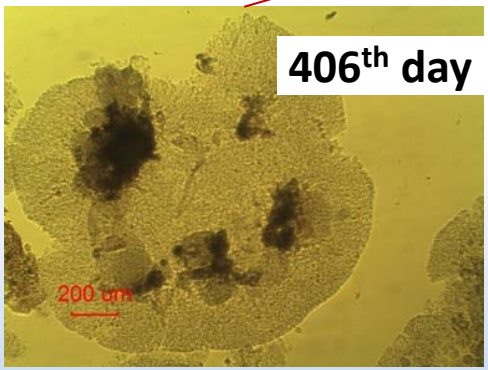
SVI – sludge volume index *HV – hindered settling velocity* *SRF– specific resistance to filtration*

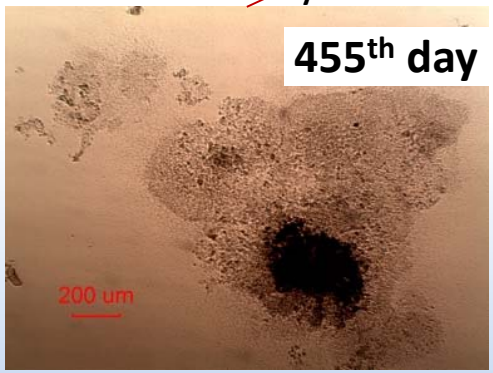

180th day
200 um

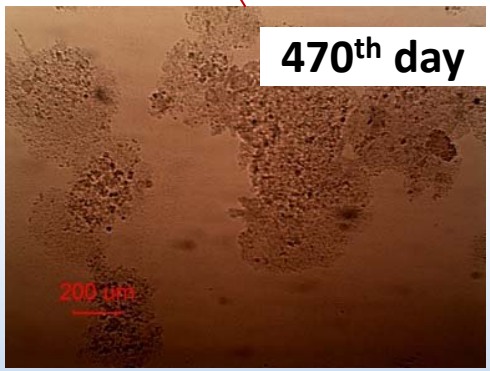

348th day
200 um

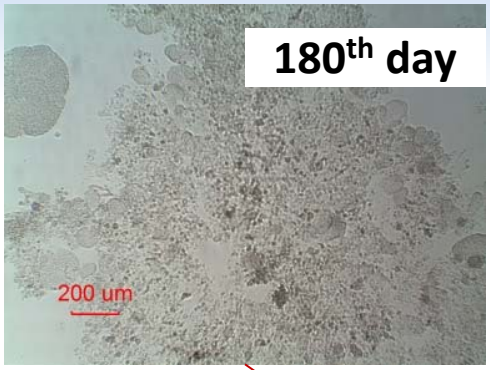

381st day
200 um

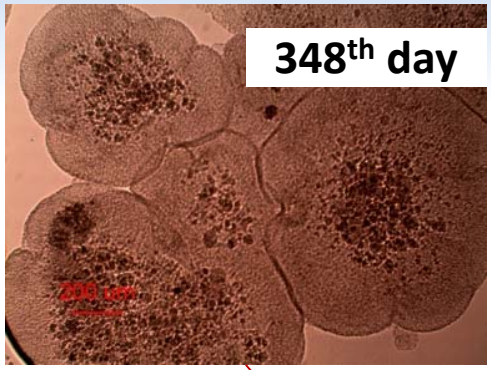

Without AlCW
With AlCW
SVI
SRF
HV
SFR (×1015 m/kg)
SVI (mL/g)
HV (m/h)
250
200
150
100
50
0
6
5
4
3
2
1
0
1
36
71
106
141
176
211
246
281
316
351
386
421
456
Day


406th day
200 um

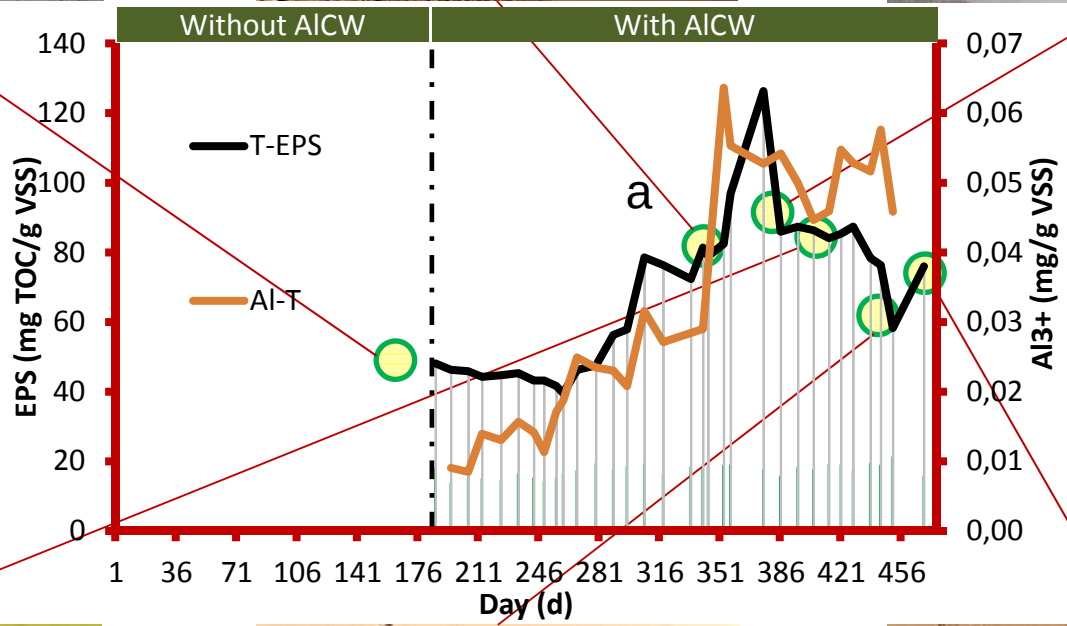

455th day
200 um

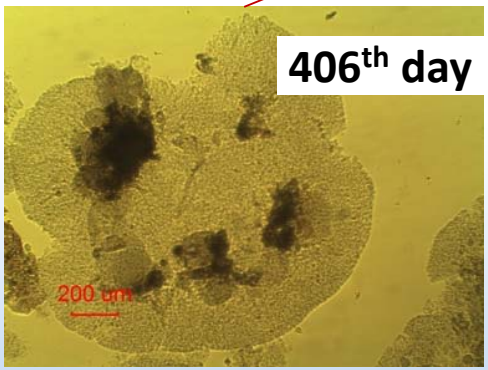

470th day
200 um

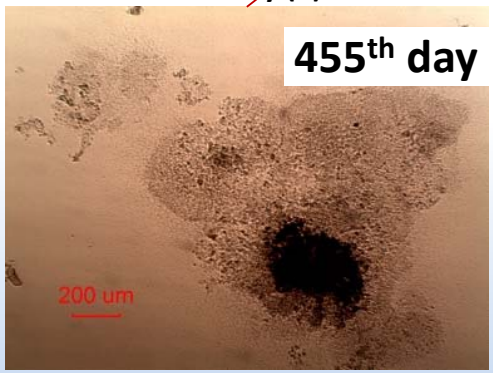

180th day
200 um

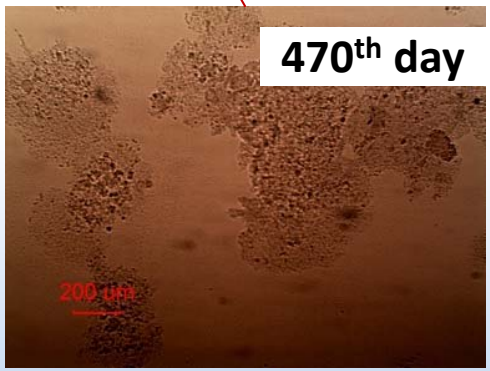

348th day
200 um


381st day
200 um

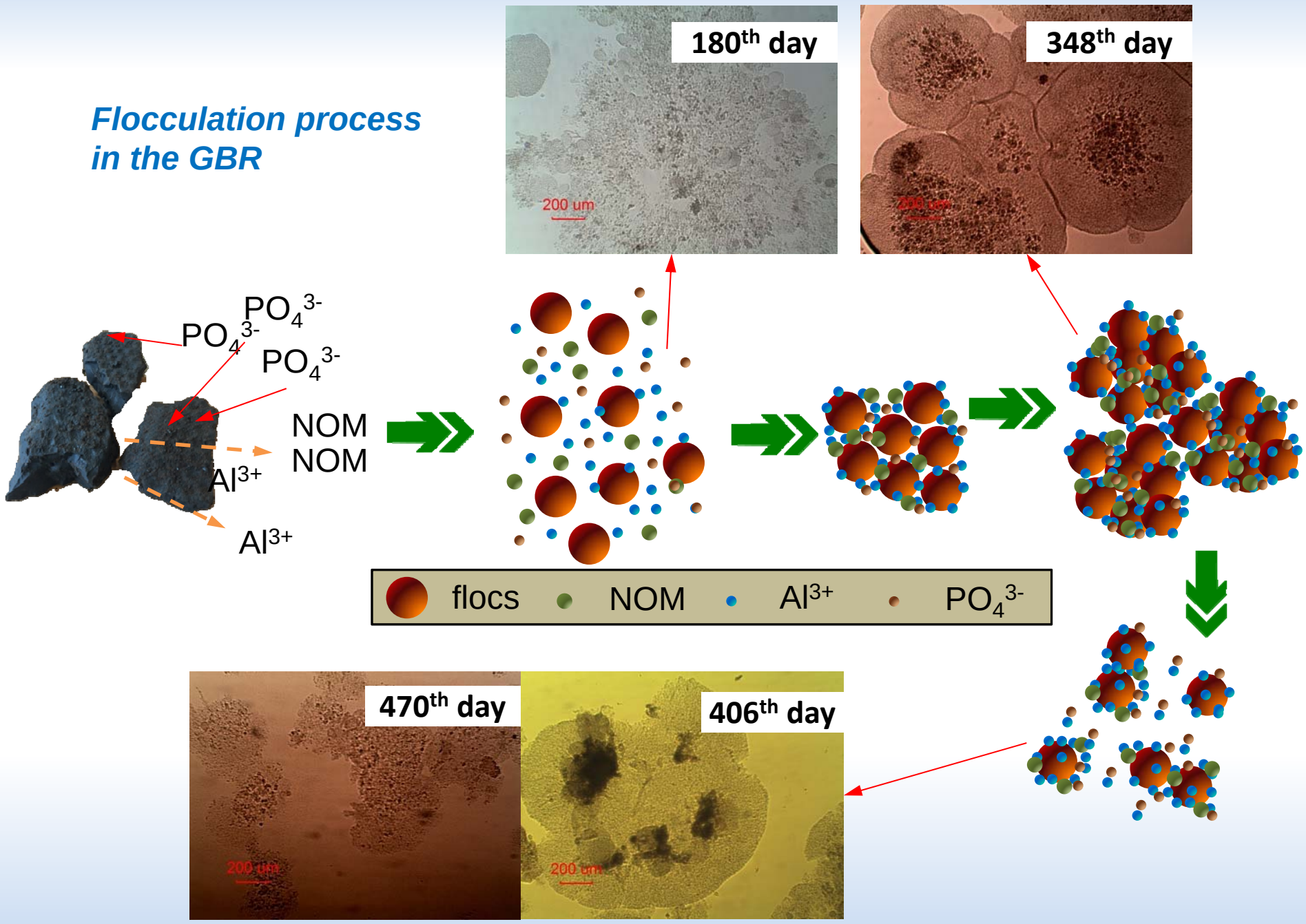

Without AlCW
With AlCW
T-EPS
Al-T
a
EPS (mg TOC/g VSS)
Al3+ (mg/g VSS)
Day (d)
0
20
40
60
80
100
120
140
0,00
0,01
0,02
0,03
0,04
0,05
0,06
0,07
1
36
71
106
141
176
211
246
281
316
351
386
421
456


406th day
200 um


455th day
200 um


470th day
200 um

Flocculation process in the GBR



Conclusion

"Al^{3+} release is *within the safe level* in the GBR"

"Alum sludge utilization has *no inhibition* on the nitrifiers and heterotrophy but *depresses* the PAOs"

"Alum sludge *deteriorates* the sludge's compressibility"

"Alum sludge *improves* the sludge's settleability and dewaterability under static operation"

"Therefore, alum sludge utilization in the conventional activated sludge is possible and in line with the *'reduce, recycle and reuse'* "

UCD DUBLIN

Thanks!
Question?