Istituto di Ricerca Sulle Acque

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IRSA CNR

An innovative system for reducing sewage sludge production

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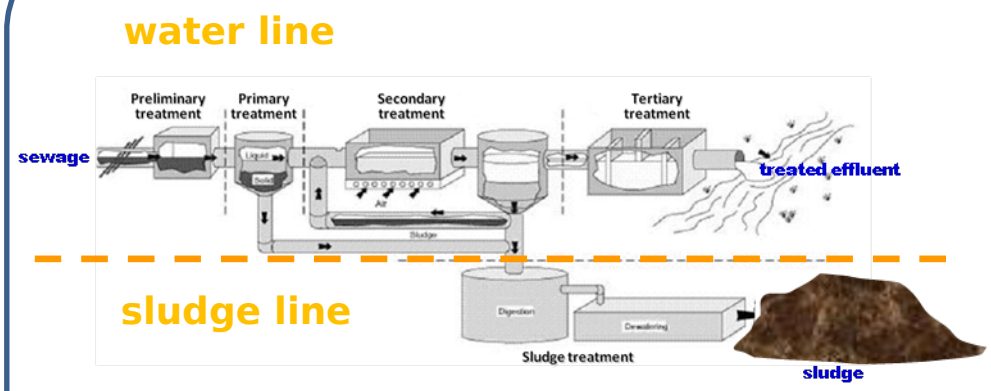
Problem definition

The management of sludge originating from wastewater treatment plants is currently one of the most critical issues of the whole treatment cycle of municipal sewage. In fact, although the sludge volume produced by sewage treatment plant represents only 1% of the volume of sewage flowing in the plant, its treatment and final disposal entail up to 60% of the total operating costs of the plant.

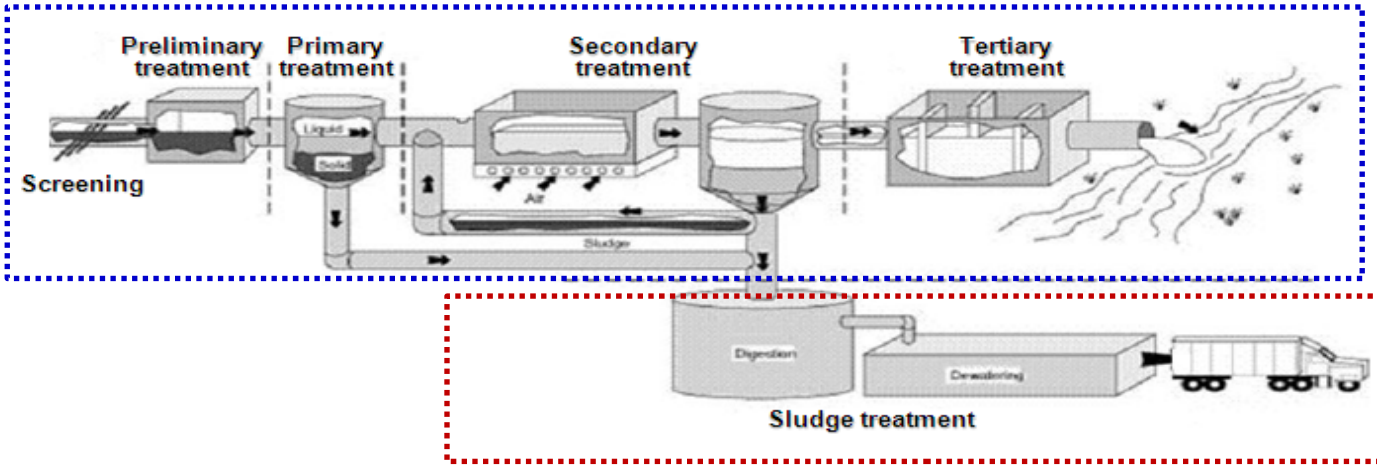


conventional sewage treatment plant

Sewage sludge reduction

Several techniques for sludge minimization have been proposed in the last decade although their application at the full scale is still relatively limited. These approaches can be classified on the basis of the location of the plant where minimization takes place:

- **Techniques for water line (“at source”)**
- **Techniques for sludge line (“downstream”)**



water line

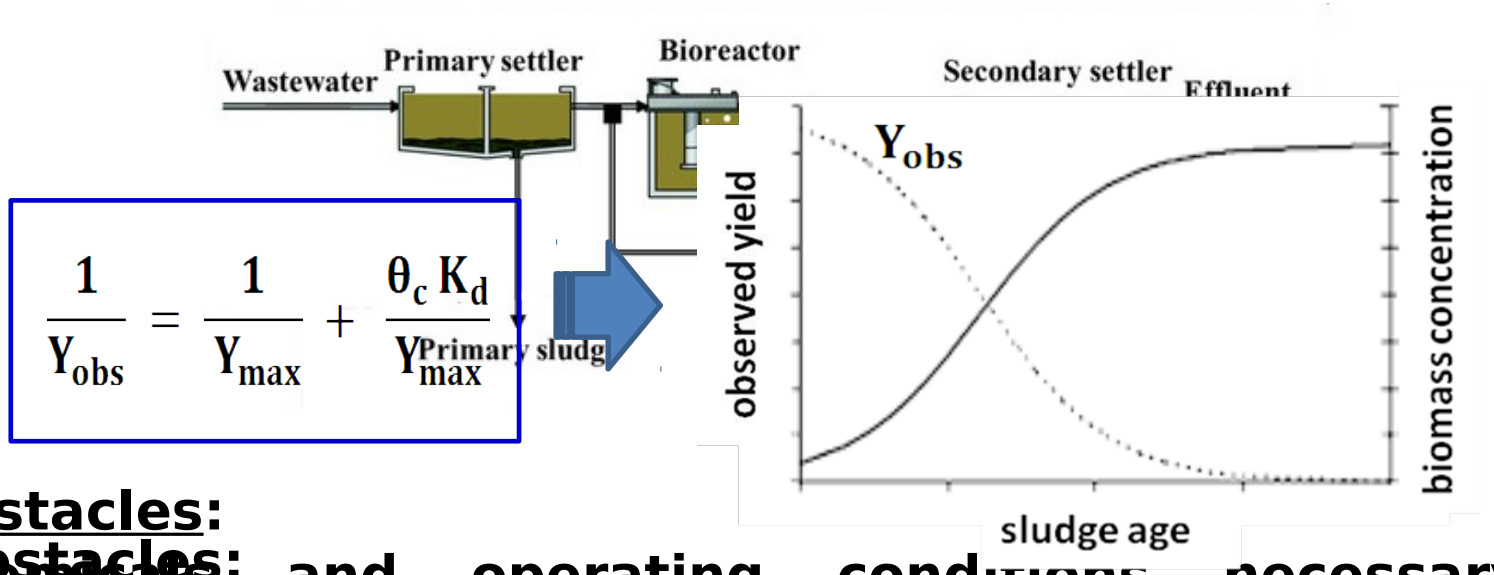
sludge line

Reducing sludge production in water line

The main mechanisms exploited for sludge reduction in the water line are based on: 1) cell lysis and cryptic growth, 2) maintenance metabolism.

2) Maintenance metabolism

1) Cell lysis and cryptic growth



Obstacles:

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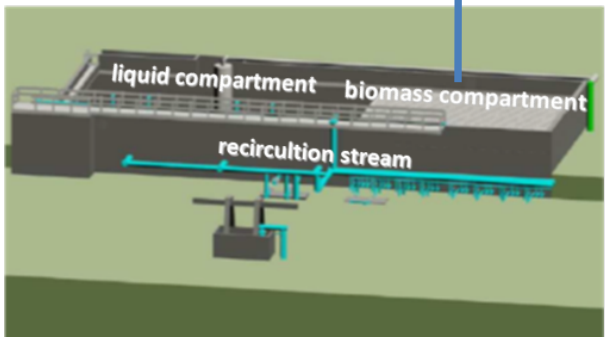
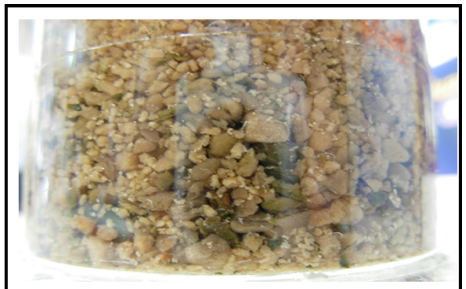
Chemicals and operating conditions necessary for achieving significant reductions of sludge production can negatively affect the purification process as well as make it expensive.

- **low biomass settling velocity**
- **biomass suspension and mixing**

MULESL: a maintenance metabolism based system





granular biomass fraction

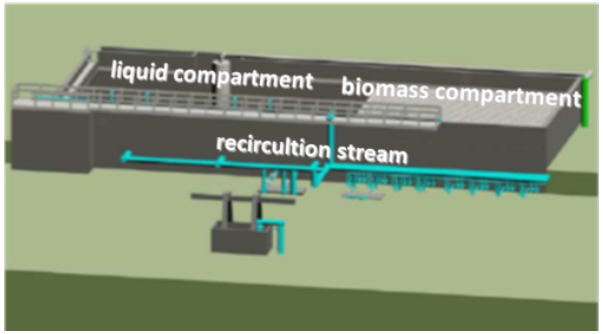
In the last decade, a new system, whose acronym is MULESL (Much Less SLudge), with sludge age greater than 120 days was developed by the Water Research Institute of Italian CNR.

MULESL can be obtained by converting the biological stage of the conventional WWTP.

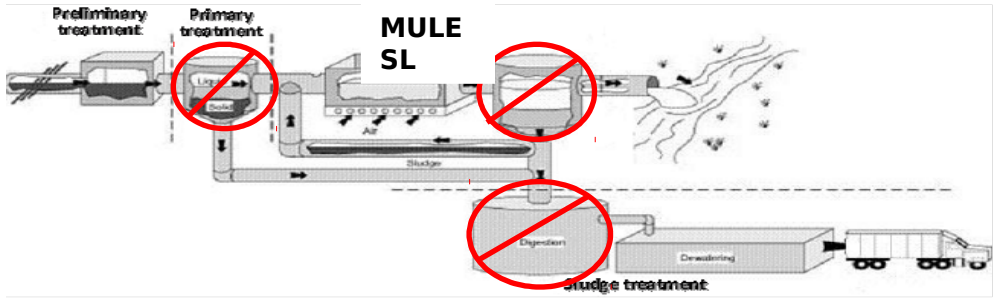
MULESL allows to transform the existing activated sludge in a particular kind of sludge made up of biofilm and granules bounded in a plastic porous material.

Thanks to its physical and biomass features, MULESL allows to obtain the separation of the biomass from the liquid phase at the same time of the treatment, thus allowing to reach high biomass concentration without the need of sedimentation stage.

MULESL features

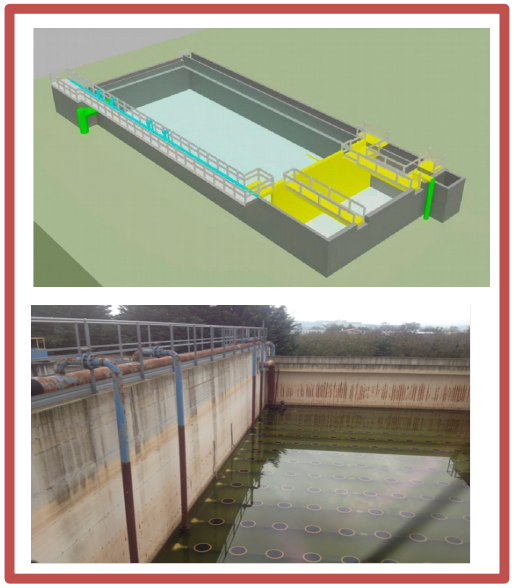


- No primary and secondary clarifiers
- High biomass concentration (up to 30 kg/m³)
- Long sludge age (>120 days)
- Low sludge production (up to 80% less)
- Treatment scheme simplification
- High quality effluent



Full scale MULESL

In 2016 the first demonstrative full scale plant based on MULESL system (3,500 PE) was designed and built in Putignano WWTP (Italy), by retrofitting an existing AS unit. The plant came into operation at the end of 2017.

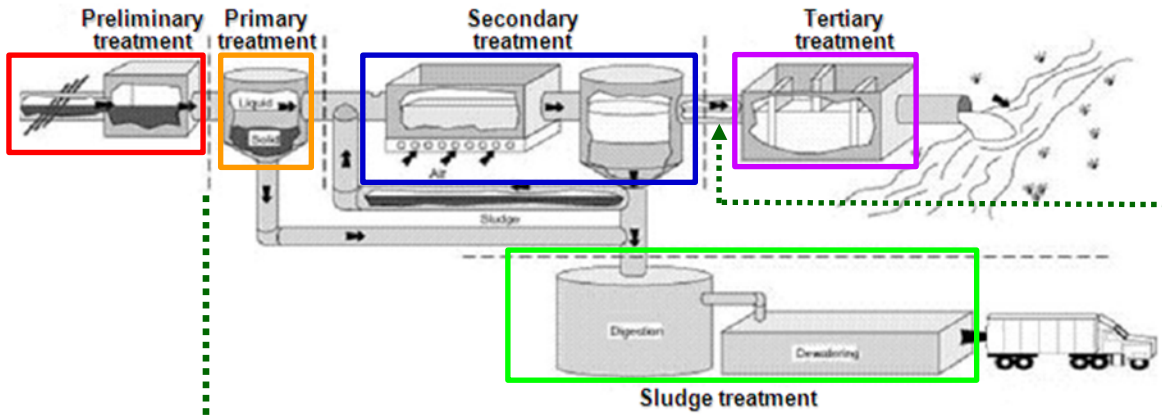


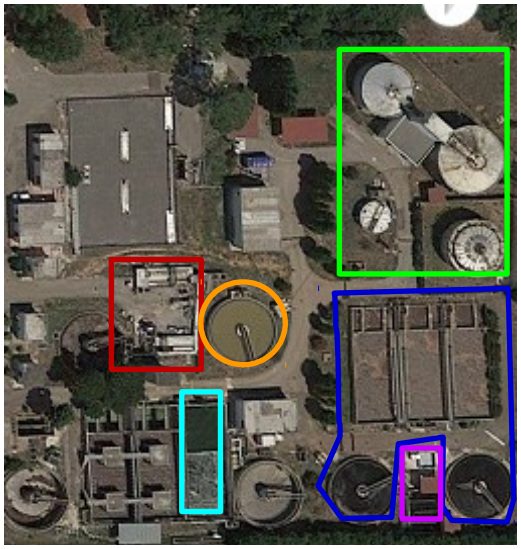
existing AS unit

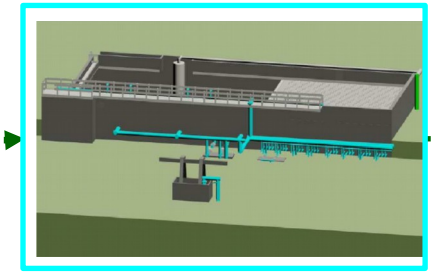
MULESL unit

Sewage sludge reduction at full scale

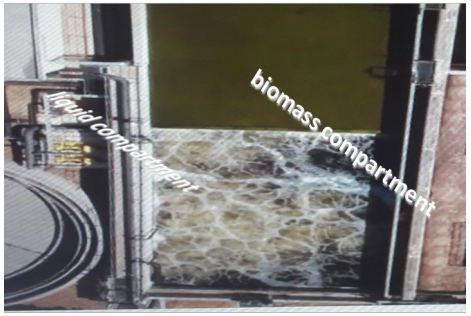
Putignano WWTP (28,000 PE)





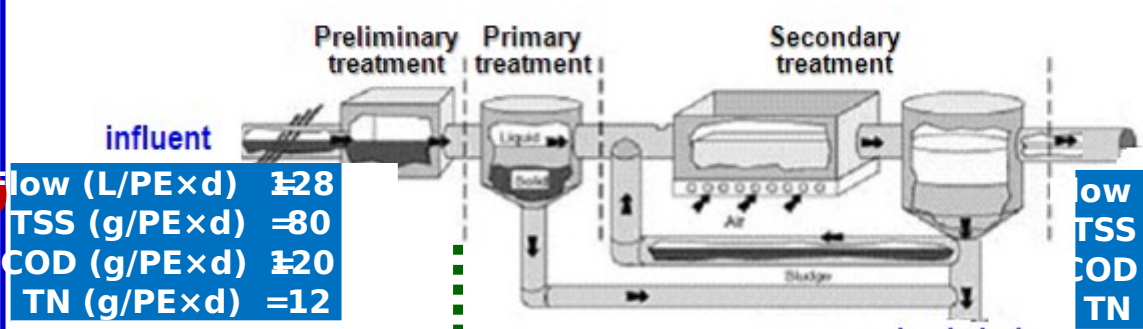


MULESL WWTP (3,500 PE)



Conventional vs MULESL WWTP

Putignano WWTP (28,000 PE)

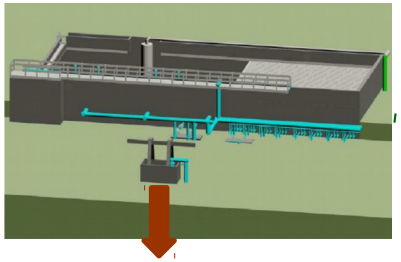


influent
Flow (L/PE×d) = 128
TSS (g/PE×d) = 80
COD (g/PE×d) = 120
TN (g/PE×d) = 12

effluent
Flow (L/PE×d) = 123.6
TSS (g/PE×d) = 2.5
COD (g/PE×d) = 6.2
TN (g/PE×d) = 1.8

mixed sludge
Flow (L/PE×d) = 4.4
TSS (g/PE×d) = 69.0
TN (g/PE×d) = 2.8

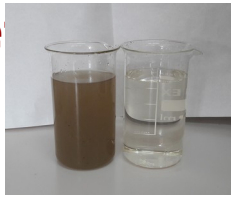
MULESL WWTP (3,500 PE)



sludge
Flow (L/PE×d) = 0.8
TSS (g/PE×d) = 15.6
TN (g/PE×d) = 0.6

Flow (L/PE×d) = 127.2
TSS (g/PE×d) = 1.0
COD (g/PE×d) = 4.2
TN (g/PE×d) = 0.5

lower TN and TS content in the e



sludge reduction of 77%

Conclusions

- A new system (MULESL) for reducing sewage sludge production in the water line of WWTP was successfully implemented at full scale by converting an existing AS basin;
- MULESL operated in parallel with the traditional water line of WWTP;
- A sludge reduction of 77% was obtained compared to the traditional water line based on primary and secondary treatment;
- An improvement of the effluent quality was also observed, especially in terms of nitrogen and suspended solids.

THANK YOU!

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