# Best Available Techniques (BAT) for Municipal Wastewater Management

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SYKE

# Contents

# Definition of BAT and its role in environmental permiting

- BAT in Finnish Act for Environmental Protection:

*”as effective as possible, technically and economically applicable production and treatment technologies and designing, constructing and operation methods, that ensures best possible environmental protection.”*

- Principle of Best Avsilsble Technology:
  - Environmental permits must be based on best available technology, when there is a risk of pollution

- BAT in environmental permits
  - Local circumstances, and economical and technical possibilities to implement pollution prevention, are taken into account when conceding about environmental permits.
- BAT permit applications
  - Permit application must include assessment of BAT for the planned activity (YSA 9§)
  - Assessment of BAT (YSA 37§)
    - 12 issues to be considered, e.g. amount, quality and impacts of emissions, energy efficiency, risk assessment and integrated impacts to the environment.

# BAT in EU statutes

- IPPC directive (2008/1/EU)
  - For prevention of pollution and decreasing of emissions
  - Included in IE-directive 2010
- IE directive (75/2010/EU)
  - For industrial emissions
  - Makes BAT deductions and emission level recommendations in reference documents (BREF) binding
  - Applied only in defined fields of operation, urban wastewater treatment is not included → national BAT
- National BAT report
  - No binding limits
  - Same objective as with real BREF, promotes environmental protection and harmonizes permitting processes

# Data used

- Data from 57 urban wwtp:
  - Small (< 1 000 $m^3$/d) – 13
  - Medium (1 000 – 10 000 $m^3$/d) – 24
  - Large (> 10 000 $m^3$/d) – 20
- Pretreatment
  - All plants have screening. Grit removal is missing only in some small plants, usually it is aerated.
  - Preaeration or aerated grit removal in most plants.
- Biological processes
  - Activated sludge in 54 plants, biologic filter in 2, rotating biological conductor (RBC) in 1

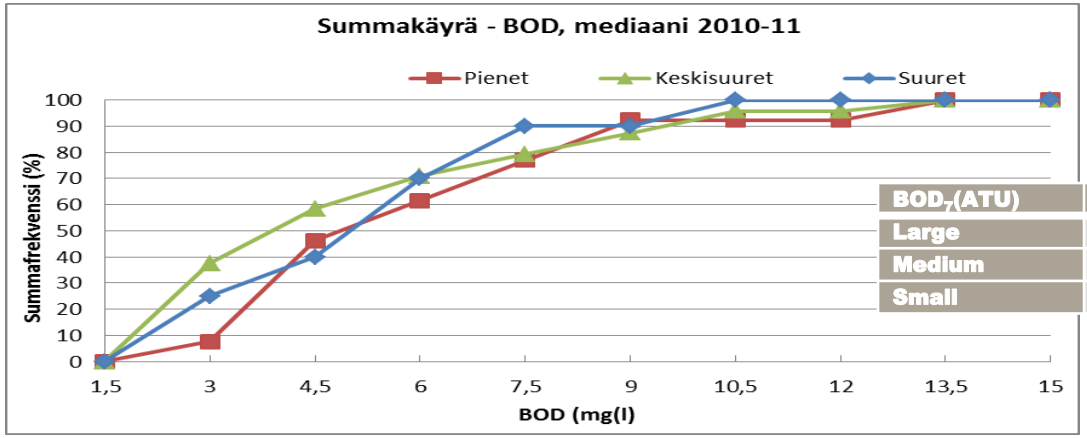
# Data used

- Tertiary treatment
  - As tertiary treatment there are flotation, tertiary sedimentation, sand filtering and biological filter for denitrification.
- Data analyses:
  - Effect of tertiary treatment
  - Sum functions for treatment efficiencies of different parameters
  - Correlation between energy and chemical consumption and treatment efficiency
  - Cost assessment

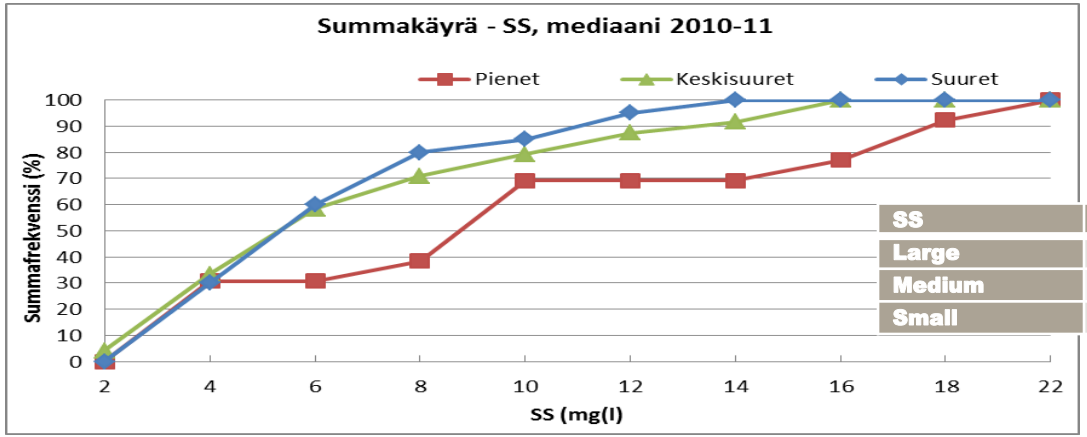
# Contents of UWWT BAT report

1. Introduction
2. Common information about Finnish waters
3. Load of urban wastewaters
4. Current load, consumption and emission levels
5. Technologies taken into account in defining BAT
6. BAT conclusions
7. New technologies
8. Conclusions and recommendations
9. References

# Current emission levels ($BOD_7$(ATU) ja SS)

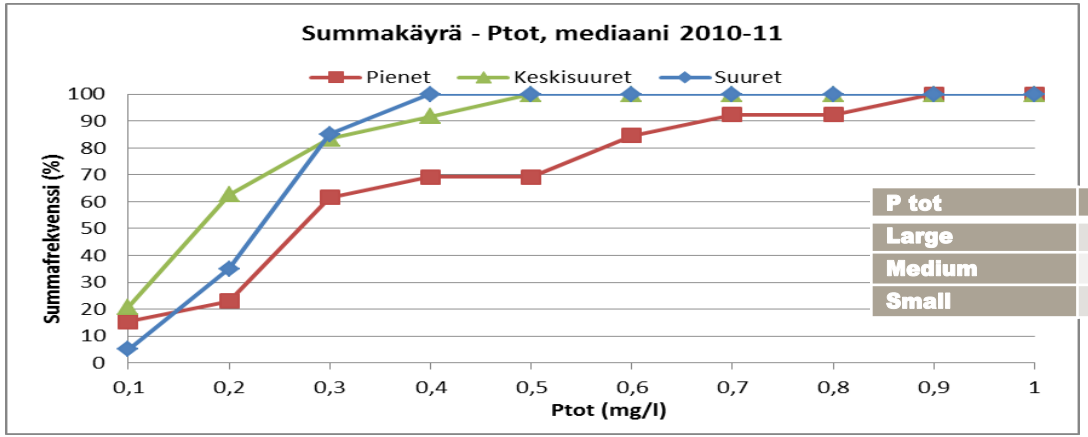



| $BOD_7$(ATU) | 100 % | 90 % | 75 % | 50 % |
|---|---|---|---|---|
| Large | 10,5 | 7,5 | 6,4 | 5,0 |
| Medium | 13,5 | 9,6 | 6,7 | 3,9 |
| Small | 13,5 | 8,9 | 7,3 | 4,9 |

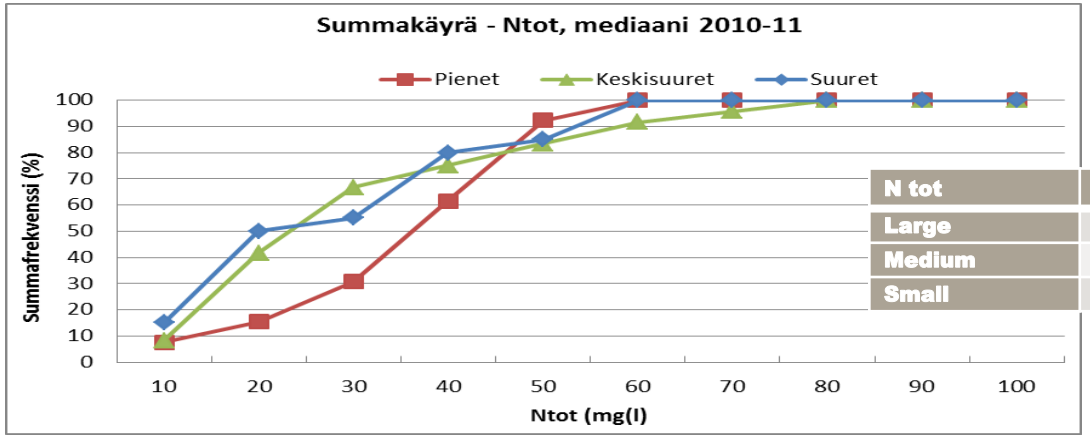



| SS | 100 % | 90 % | 75 % | 50 % |
|---|---|---|---|---|
| Large | 14 | 11 | 7,5 | 5,4 |
| Medium | 16 | 13 | 9,0 | 5,4 |
| Small | 20 | 18 | 15 | 8,8 |

# Current emission levels ($P_{tot}$ ja $N_{tot}$)

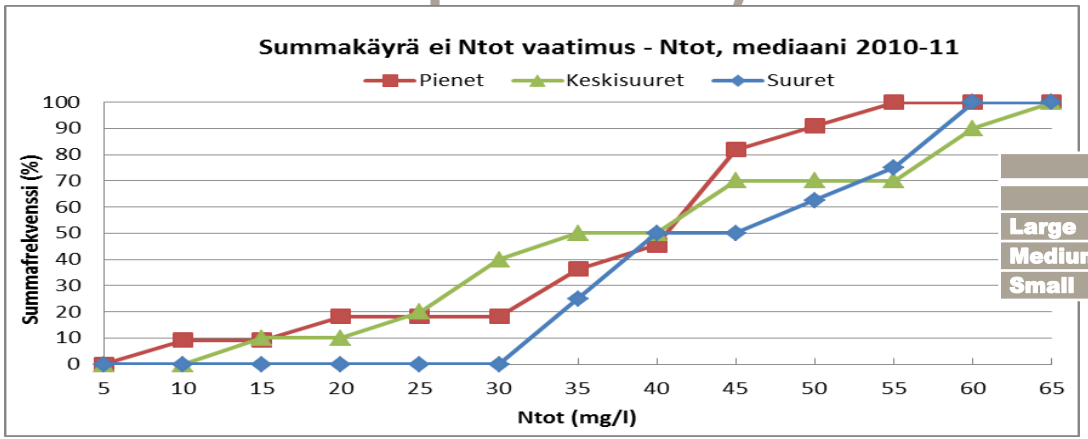



| P tot | 100 % | 90 % | 75 % | 50 % |
|---|---|---|---|---|
| Large | 0,4 | 0,33 | 0,28 | 0,23 |
| Medium | 0,5 | 0,38 | 0,26 | 0,17 |
| Small | 0,9 | 0,67 | 0,54 | 0,27 |




| N tot | 100 % | 90 % | 75 % | 50 % |
|---|---|---|---|---|
| Large | 60 | 54 | 38 | 20 |
| Medium | 80 | 58 | 40 | 24 |
| Small | 60 | 49 | 45 | 37 |

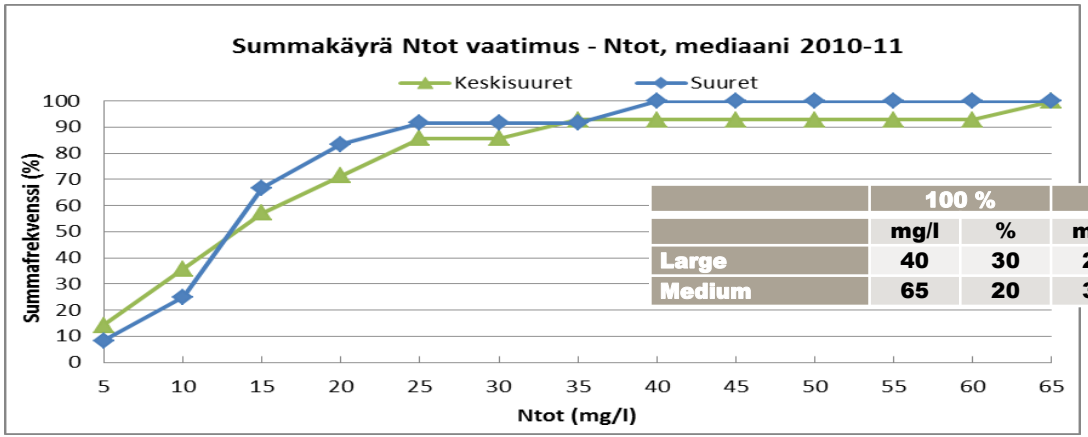
# Current emission levels (according to $N_{tot}$ reduction requirement)




No Ntot requirement

| | 100 % | | 90 % | |
|---|---|---|---|---|
| | mg/l | % | mg/l | % |
| Large | 60 | 0 | 58 | 8 |
| Medium | 65 | 20 | 60 | 23 |
| Small | 55 | 20 | 50 | 24 |

| 75 % | | 50 % | |
|---|---|---|---|
| mg/l | % | mg/l | % |
| 55 | 13 | 40 | 30 |
| 57 | 26 | 35 | 40 |
| 44 | 29 | 41 | 34 |




Ntot requirement

| | 100 % | | 90 % | | 75 % | | 50 % | |
|---|---|---|---|---|---|---|---|---|
| | mg/l | % | mg/l | % | mg/l | % | mg/l | % |
| Large | 40 | 30 | 25 | 52 | 18 | 70 | 13 | 76 |
| Medium | 65 | 20 | 33 | 44 | 22 | 57 | 13 | 66 |

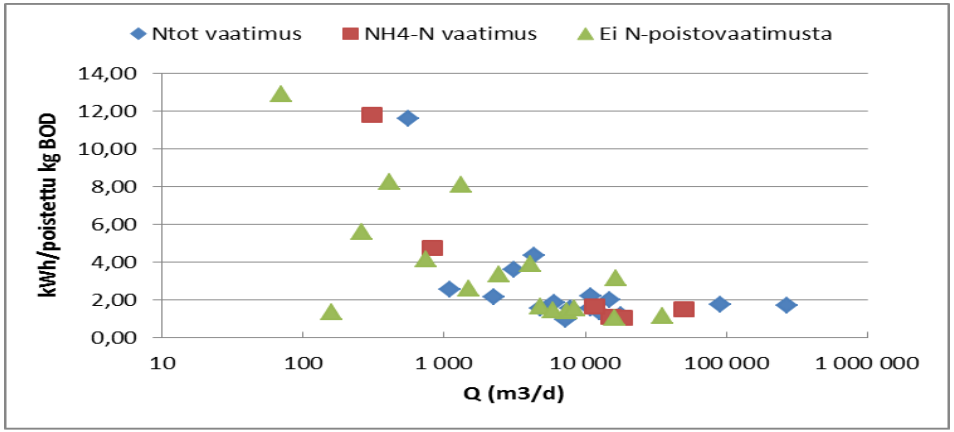
# Current energy  consumption

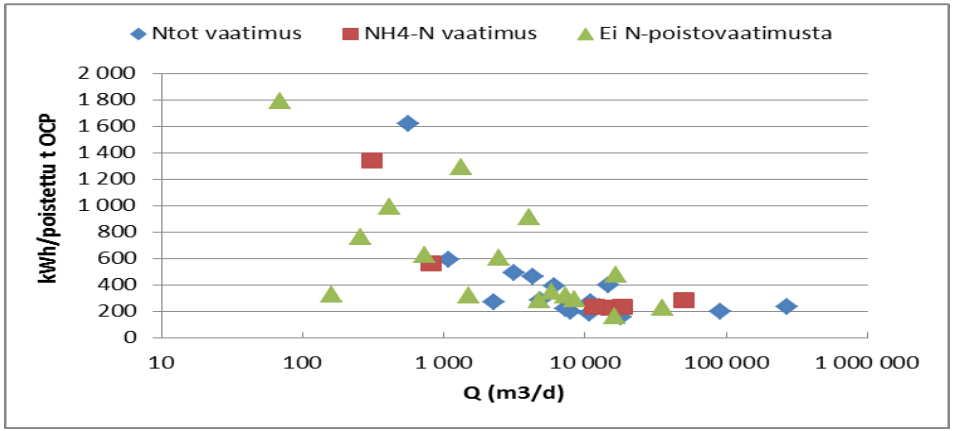
- Energy consumption is compared with
  - Mean discharge
  - Mean treatment efficiency
    - $BOD_7$ (mg/l)
    - $BOD_7$ ja OCP (kWh/kg ja kWh/t)
- Energy consumption:
  - < 0,50 kWh/m3
  - 0,51 – 1,00 kWh/m3
  - > 1,00 kWh/m3

# Current energy consumption

| Energy consumption (kWh/m3) | Mean discharge (m3/d) | Mean BOD7 mg/l in effluent | Energy consumption kWh/removed BOD7kg | Energy consumption kWh/removed OCPt |
|---|---|---|---|---|
| < 0,50 | 37 875 | 7,24 | 1,54 | 274,6 |
| 0,51 – 1,00 | 6 442 | 5,96 | 2,52 | 396,6 |
| > 1,00 | 1 322 | 7,42 | 6,95 | 964,1 |

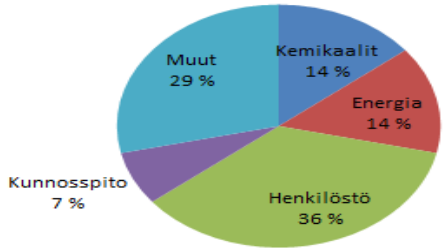
# Current energy consumption



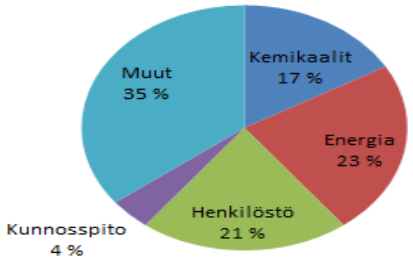



# Current cost levels

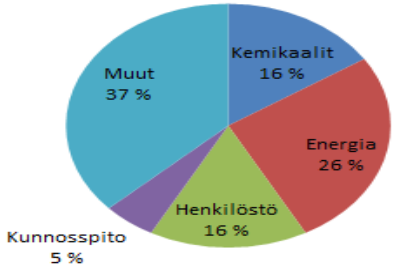
Small

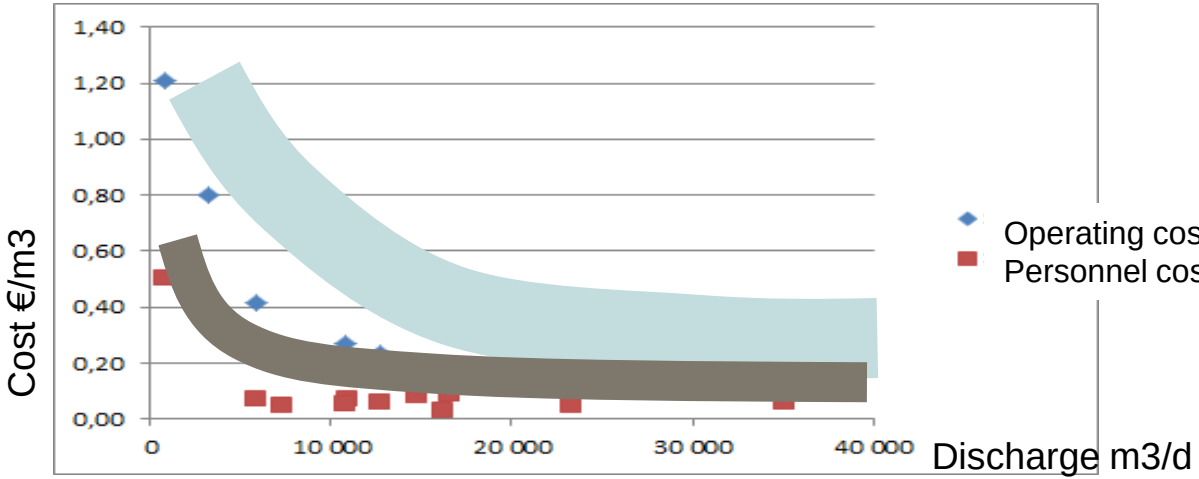



Medium




Large



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# BAT conclusions by process units

- Incoming wastewater and primary treatment
  - There must be at least one spare pump available for incoming wastewater
  - Every plant has to have a screen or similar mechanical equipment
  - Primary treatment must be located indoors to ease the maintenance and to control the odor nuisance
- Biological and chemical process
  - Optimization of energy and chemicals consumption
  - The biological process must consist of two lines when Q > 1000 m3/d
  - Spare equipment, double lines and reserve power

# BAT conclusions by process units

- Tertiary treatment
  - Selection of suitable method for different cases (P or N removal, hygienization)
- Sludge treatment
  - Spare equipment and double lines
  - Enough storage
  - Backup plan for transporting

# BAT conclusions

## Plant and process design

- Issues to be considered in process design: sufficiency of dimensioning, proper sludge circulation.
- Examination of the sub-processes: the necessity of some unit processes, duplication and spare parts for those processes.
- It should be possible to by-pass the different units during maintenance.
- The efficient mixing of chemicals must be ensured.
- The precipitation chemical should be dosed in relation to the influent volume or load. Ferrous sulfate, however, can be dosed with uniform flow.
- It should be possible to decrease the load to the biological unit with pre-precipitation, when necessary.

# BAT conclusions

## Operation and maintenance

- Modern instrumentation and automation should be utilized to increase the reliability and to decrease risks.
- It’s necessary to observe the energy efficiency in planning as well as operation and maintenance, and to secure the energy availability.
- Reliability of monitoring and assessment of emissions.
- The sufficiency of the process chemicals is secured by following storage situation.
- The measuring devices’ calibration must be up to date.
- Energy consumption should be monitored separately in each part of the process

# BAT conclusions

## Automation

- It should be possible to operate the plant with automation and without manning.
- Process equipment failures should cause an alarm that is directed to a person on call.
- Process automation should be equipped with UPS-devices.
- By-passing situations should cause an automatic alarm.

# BAT conclusions

## Best environmental practices (BEP)

- There must be enough educated staff for operating the plant.
- The staff should be offered a chance to maintain and develop their skills by sufficient and diverse education.
- The plant should reduce energy consumption and use self-produced energy, whenever possible.
- Clients of the WWTP are informed and educated about the possibilities and limitations of the wastewater treatment process to e.g. diminish the amount of harmful substances in sewage.

# New techniques

- Technologies that have been tested, but are not yet widely used in Finland
- Technologies presented in this section are believed to be widely used in near future
  - Membrane techniques
  - Nanotechnology
  - N removal
  - Hygienisation
  - Sludge treatment
  - Removal of harmful substances

# Best environmental practices in sewer management

- Not considered as BAT, no emission limits
- BEP for sewer network management
- Defined and processed by an expert group including researchers and representatives from water utilities, consultants, contractors and authorities
- The purpose of this BEP report is to give a wide understanding about issues to be taken into account when designing, constructing and maintaining sewer networks. One target is to decrease the load of sewer overflow and the load to surface and ground waters.

# Best environmental practices in sewer management

## Planning

- Personnel
- Land use and soil conditions
- Detailed planning
- Dimensioning and responsibilities
- Energy issues

**Example:** *The design must take into account the specific properties of the object, the soil type, the surface contours and other structures, and select the appropriate sewage material and the construction / renovation method.*

# Best environmental practices in sewer management

## Building

- Personnel
- Soil construction
- Supervisioning

**Example:** *In addition to the appropriate skills, contractors must have the appropriate tools and work safety issues in order.*

# Best environmental practices in sewer management

## Maintenance

- Spatial, condition and quality data and information
- Risk assessment
- Renovation

**Example:** *When designing the need for repairs or renovations, special attention should be paid to cost-effectiveness, and the risks to the environment, health and well-being.*

# Conclusions

- These BAT and BEP reports were carried out by working groups of water services experts lead by Finnish Environment Institute.
- The working groups analyzed the collected data and according to this analysis as well as their experience, the group members formed the BAT and BEP conclusions.
- The main target of the reports and the conclusions is to assist and guide the permit authorities, applicants and designers.
- As the requirements of legislation may get stricter and as the treatment technologies develop, it is reasonable to assess BAT in about five years cycle to ensure that the presented techniques truly are best available for the time being as well as in the future.

# Thank you!

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