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BASIC DATA REQUIRED FOR WASTEWATER TREATMENT PLANT DESIGN

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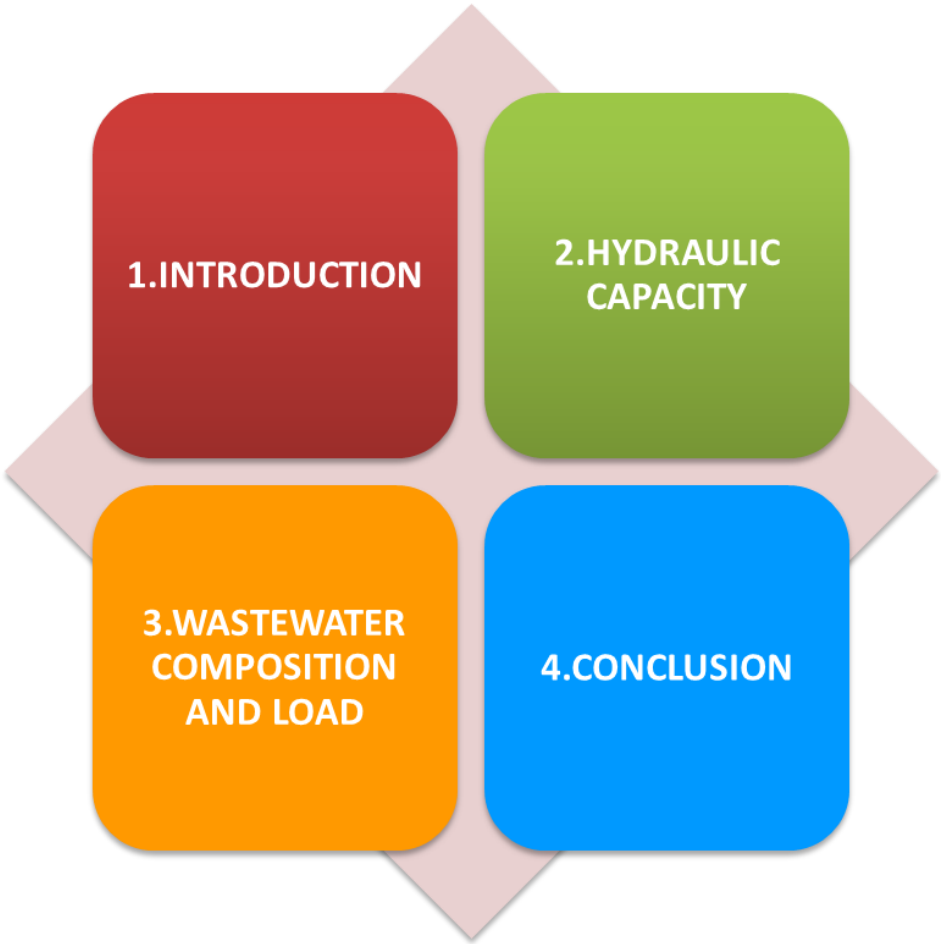
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1. INTRODUCTION

- Wastewater collection, treatment, and disposal facilities are designed to handle specific hydraulic and pollutant loads for 20 or more years after they are constructed.

- **To properly size and equip such facilities, it is important the total population by the end of the planning period, the flow of wastewater (and stormwater) that will be diverted into the system from that population, and quantities and types of pollutants in the wastewater.**

2. HYDRAULIC CAPACITY

- **Hydraulic capacity of the wastewater treatment plant (WWTP) can be quantified in three different ways:**

i. ***Measuring water supply:*** The generated amounts of wastewater can be derived from the total water supply for domestic, industrial and commercial uses.

Not favoured method since it is difficult to make countrywide estimates for the amounts of water supplied from alternative non-public sources such as private water vendors, rainwater harvesting, and springs.

ii. ***Measuring wastewater flows:*** This method measures only the metered wastewater flows from sewered communities.

The amounts of wastewater generated from communities using cesspits and septic tanks must to be estimated and accounted.

iii. ***Measuring water consumption*:** This method quantifies the amount of wastewater generated from domestic, commercial, and industrial water uses based on the average per capita water consumption, taking into consideration that not all the consumed water enters the sanitation system.

This technique is most recommended since it allows easy calculation and takes into consideration the water saving efforts but still we should take into consideration some data about measured wastewater flows.

Water consumption

- In European countries, water consumption on household level ranges between **80 litres/person a day in Lithuania and 250 litres/person a day in Spain.**

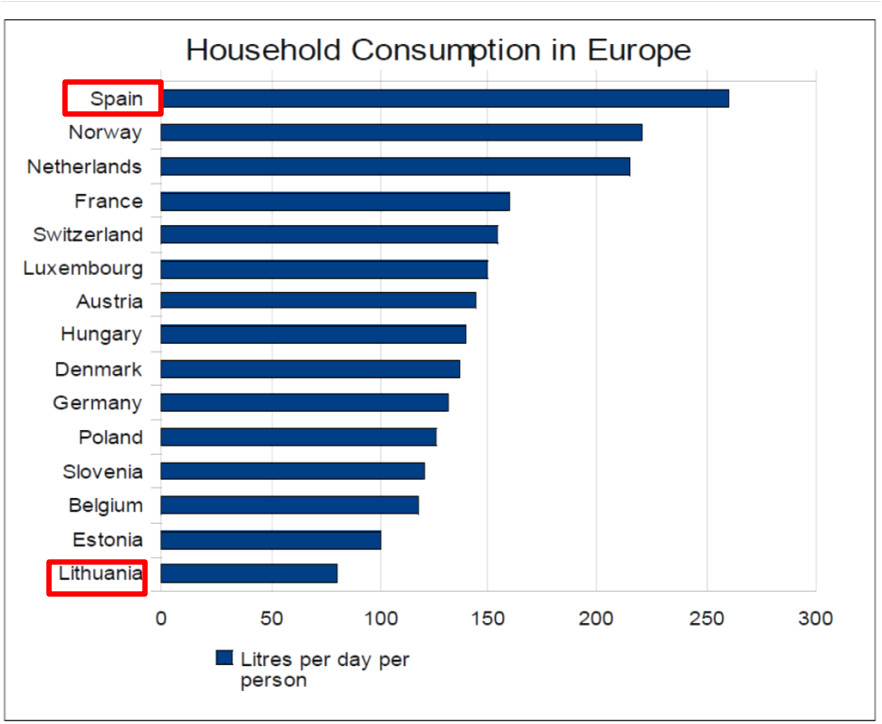


FIGURE 1. Household water use in selected European countries

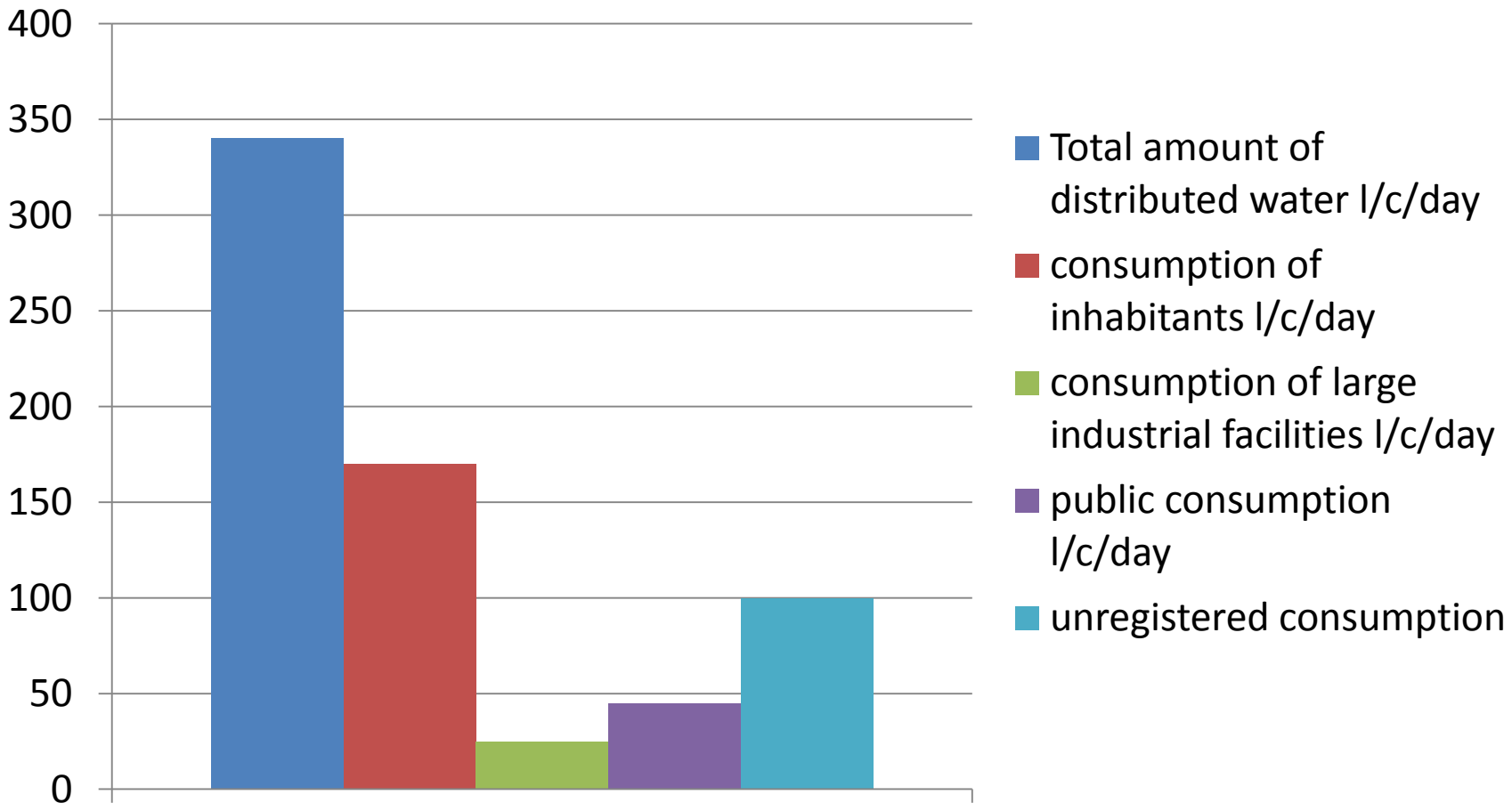
- The average water consumption in Serbia is approximately 320 litres per capita per day (L/c/d), where 400 L/c/d is the consumption of the urban population and 250 L/c/d is for rural areas.

✓ Because of poor water production measurement it is not secured that the actual water consumption is that high.

✓ It is assumed that in some cases losses of drinking water, due to the old distribution system, are up to approximately 60 %.

✓ Due the very low water price, water use per day is much higher then in industrial EU countries (the price for drinking water is 0.1 to 0.3 Euro/m^3 for households and 0.1 to 0.4 Euro/m^3 for industry).

Example of Novi Sad water distribution system



- Domestic water consumption, and hence wastewater production, typically depends on water supply service level, climate and water availability.

TABLE 1. Typical domestic water supply and wastewater production in industrial, developing and (semi-) arid regions (L/c/d)

Water supply service	**Industrial regions**	**Developing regions**	**(Semi-)arid regions**
Hand pump or well	not applicable	<50	<25
Public standpost	not applicable	50-80	20-40
House connection	100-150	50-125	40-80
Multiple connection	150-250	100-250	80-120
Average wastewater flow	**85-200**	**65-125**	**35-75**

- Domestic peak design flow rates commonly used in various countries need to take into a consideration also the commercial and industrial peak flows and, where appropriate, infiltration.
- In addition to the municipal and industrial sources of wastewater that make up the base component of a flow to a treatment plant (dry weather flow), the drainage of rainwater to WWTP (storm water flow) will also contribute to the total wastewater flow to be treated at the WWTP.
- The extent to which stormwater will impact the WWTP is related to the type of collection system in place, as **combined systems will carry much more stormwater to the WWTP than separate systems.**
- **This stormwater flow determines to a large degree the required hydraulic capacity of the WWTP.**

- **The peaking factor** is used to forecast the maximum/peaking flows.
- Peak factor is highly related to the number of consumers, the service areas, and the duration of peak flow of a water distribution network.

TABLE 4. Summary of peaking factor calculation methods

Method	Equation	Population limits
Harmon Formula (1918)	$f_h = \frac{18 + \sqrt{P/1000}}{4 + \sqrt{P/1000}}$	1 000≤P≤1 000 000
PRP-Gumbel (2005)	$f_h = 2{,}5\frac{2{,}18}{\sqrt{P/1000}}$	1 000≤P≤25 000
AWWA (2004)	$f_h = \left(\frac{1095{,}31}{q}\right)p^{0{,}4}$	650≤P≤1 675
DVGW (2007)	$f_h = 18{,}1\left(P^{-0{,}1682}\right)$	Unknown

P = population; q = water demand per 1000 people

3. WASTEWATER COMPOSITION AND LOAD

- **The composition of municipal wastewater varies significantly from one location to another**.
- **The main reasons are variations in water consumption in households and infiltration and exfiltration during transport in the sewage system.**
- Wastewater that comes from pure municipal and urban sources is of a fairly constant composition.
- If industries are also connected to the WWTP, the influent wastewater composition varies depending on the type of industry and the management**. The contaminants transported by these wastewater flows determine the (biological) capacity of the WWTP required to treat it .**

- **Person Load (PL),** can vary considerably. The reasons for the variation can be working place outside the catchment, socio-economic factors, lifestyle, type of household installation, level of facilities available for water and sanitation systems etc.

TABLE 5. Variations in person load, (g/c/d), assuming wastewater (0.05-0.40 m^3/c/d)

Parameter	Range
COD (Chemical oxygen demand)	25-200
BOD (Biochemical oxygen demand)	15-80
Nitrogen	2-15
Phosphorus	1-3

TABLE 6. Person load in various countries in kg/cap/yr

Parameter	Brazil	Egypt	India	Turkey	US	Denmark	Germany
BOD	20-25	10-15	10-15	10-15	**30-35**	20-25	20-25
TSS	20-25	15-25		15-25	30-35	30-35	30-35
N total	3-5	3-5		3-5	5-7	5-7	4-6
P total	0.5-1	0.4-0.6		0.4-0.6	0.8-1.2	0.8-1.2	0.7-1

4. CONCLUSION

- ✓ In order to select and size both collection and treatment facilities for planning period, projected wastewater flow and organic loading must be determined.
- ✓ Dry weather flows, wet weather flows, infiltration and inflow are factors that are important to design wastewater collection, treatment and disposal facilities.
- ✓ Domestic water usage, and hence the daily volume per person which arrives at sewage works, varies from one group of persons to another, and from one country to another.
- ✓ The standards for design of the wastewater treatment plant should be set according to specific condition for each country.

Thank you for your attention