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EU Green Week Partner Event

**Sewage Sludge Management and Energy Efficiency at the
Wastewater Treatment Plant Butila (Sarajevo)
Bosnia and Herzegovina**

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WASTEWATER AS A RESOURCE:
REGIONAL WORKSHOP ON
SEWAGE SLUDGE MANAGEMENT
AND ENERGY EFFICIENCY



Logo 3



Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina



Introduction

- WWTPs in Bosnia and Herzegovina
- WWTP Butila (Sarajevo)

Main Part - WWTP Butila (Sarajevo)

- * Sewage Sludge Treatment
- * Energy Efficiency

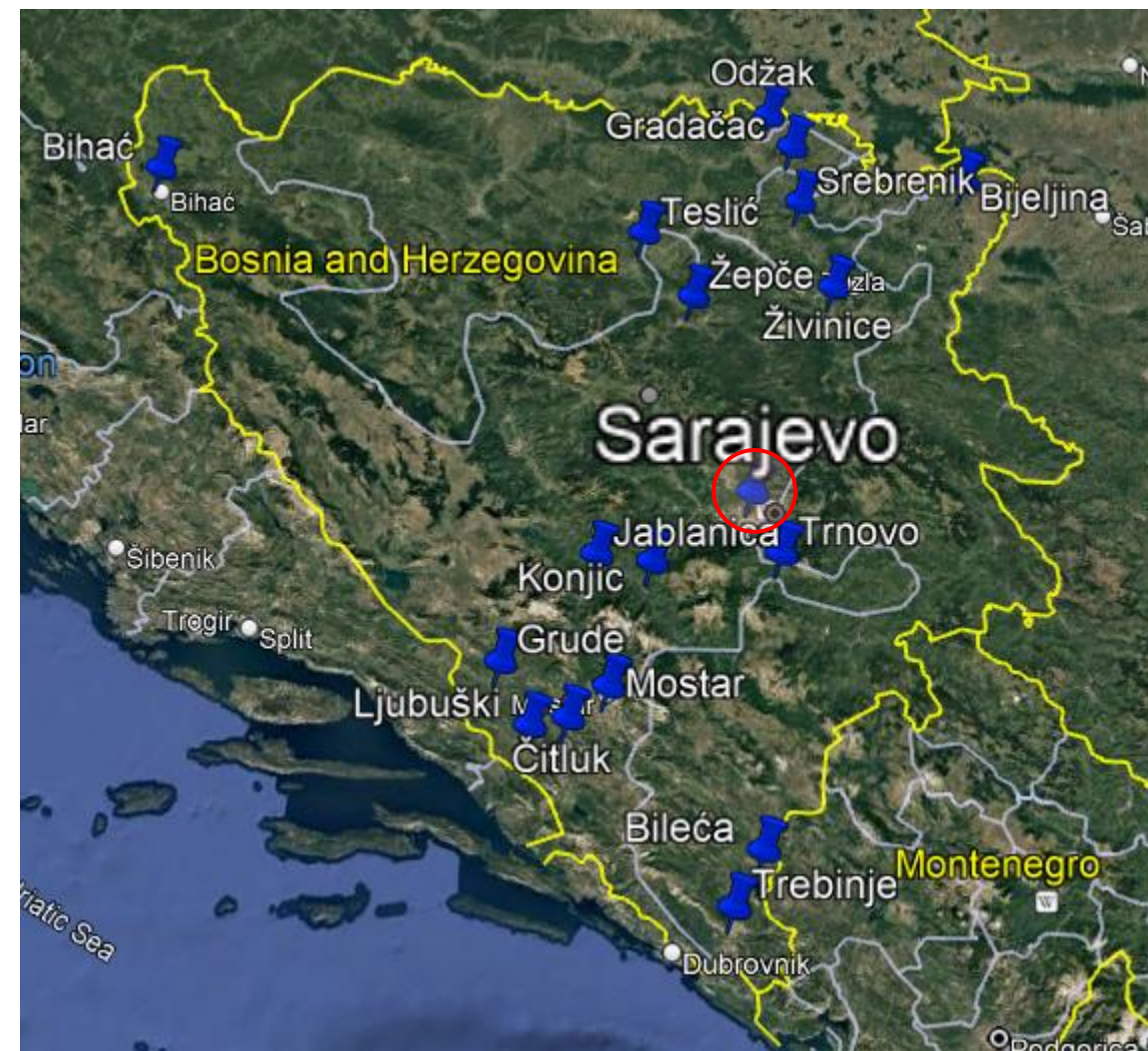
Next steps and future improvements



Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina

WWTPs in B&H					
No.	Location	Capacity (I/II phase)	No.	Location	Capacity (I/II phase)
1	Sarajevo/Butila	600.000/650.000	14	Grude	2.500/5.000
2	Bihać	55.000/82.500	15	Ljubuški	6.000/12.000
3	Odžak	10.000	16	Livno	15.500/50.000
4	Živinice	25.000/40.000	17	Bosansko Grahovo	1.650 /...
5	Gradačac	10.000/30.000	18	Tomislavgrad	6.000
6	Srebrenik	12.000	19	Kupres	5.000
7	Tešanj, Doboj j. i Usora	-	20	Žepče	5.000
8	Prozor	3.000	21	Trnovo	5.000
9	Konjic	5.000/15.000	22	Bijeljina	40.000
10	Mostar	100.000	23	Trebinje	16.000/30.000
11	Jablanica	3.250	24	Bileća	5.000/15.000
12	Čitluk	7.000/14.000	25	Teslić	20.000
13	Široki Brijeg	10.000/15.000	26	Gradiška	100.000

- In function
- Design/construction phase
- Not reconstructed
- Built but not in use

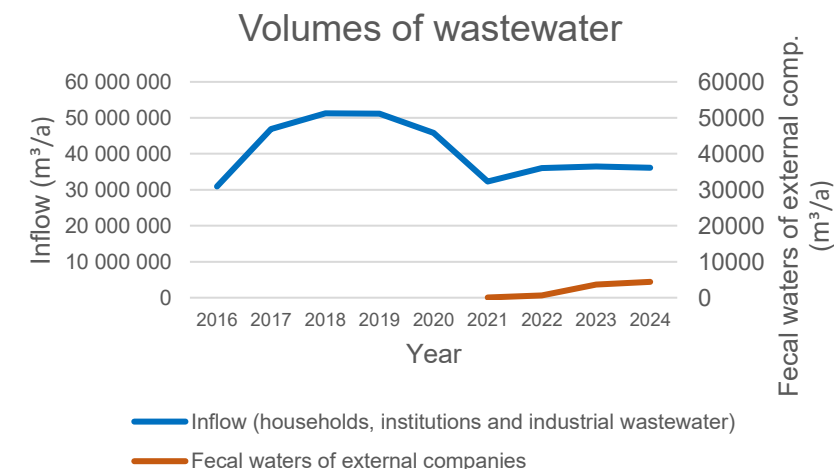
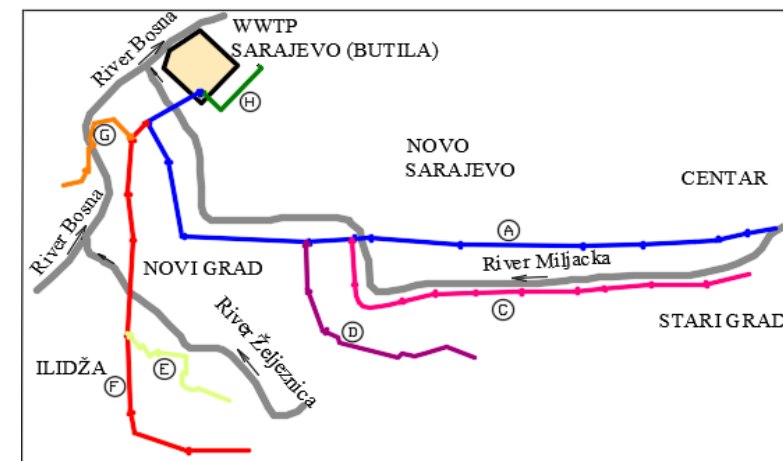


Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina

Seven main collectors → WWTP Butila The Central Sarajevo Sewerage System:

- serves about 90% of the population of Canton Sarajevo
- 413,593 people (2013.)
- covers the area of several municipalities

(Stari Grad, Centar, Novi Grad, Novo Sarajevo, Ilidža and part of Vogošća, Hadžići and part of Trnovo and a part of Lukavica and Istočna Ilidža)

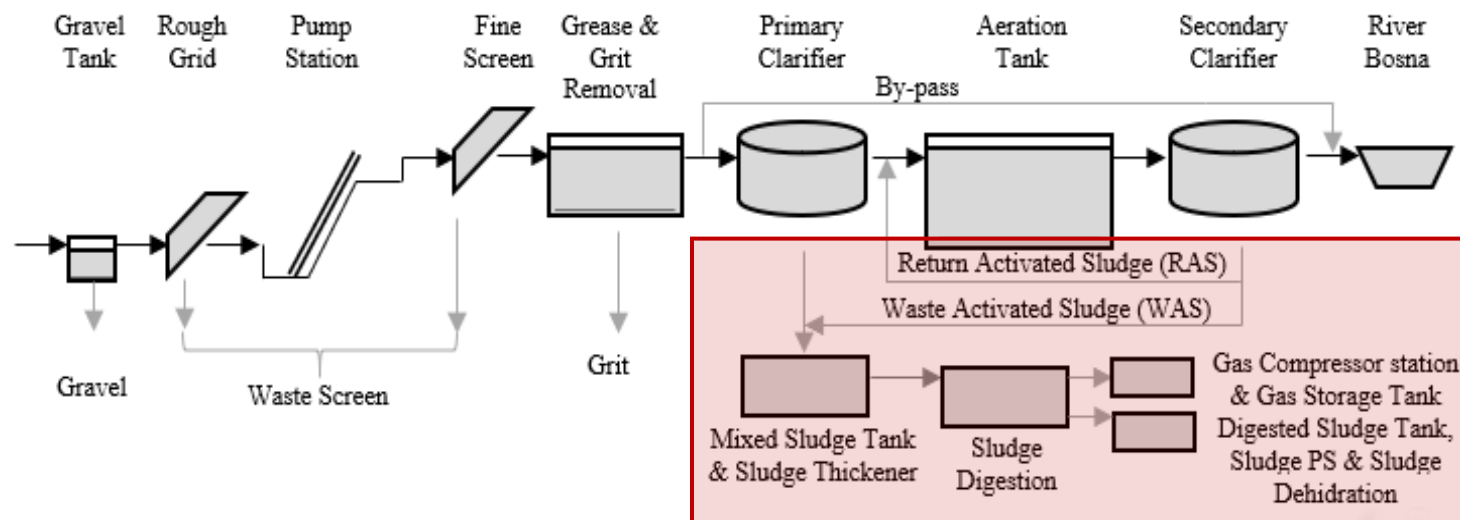


Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina

Plant:	WWTP Butila (SARAJEVO)
Commissioning (start-up):	2016 – reconstruction of the existing plant
Construction phase/year:	Phase I: 2016 Phase II: 2030
Capacity (PE):	600,000 PE (Phase I) 650,000 PE (Phase II)
Treatment technology:	Activated sludge process with suspended growth for carbon removal and nitrification, including primary sedimentation and anaerobic sludge digestion
Level of treatment:	Primary and secondary treatment (Phase I) Primary, secondary, and tertiary treatment (Phase II)
Inflow – Qavg,d	169,000.00 (m ³ /d)
Type of sewage system:	Combined sewer system
Coverage area of the sewage system:	City of Sarajevo (main city collector + Rajlovac collector)
Plant location:	The confluence of the Miljacka and Bosna Rivers (41.4 ha)
Receiving water body (recipient):	River Bosna (Effluent), River Miljacka (By-pass)

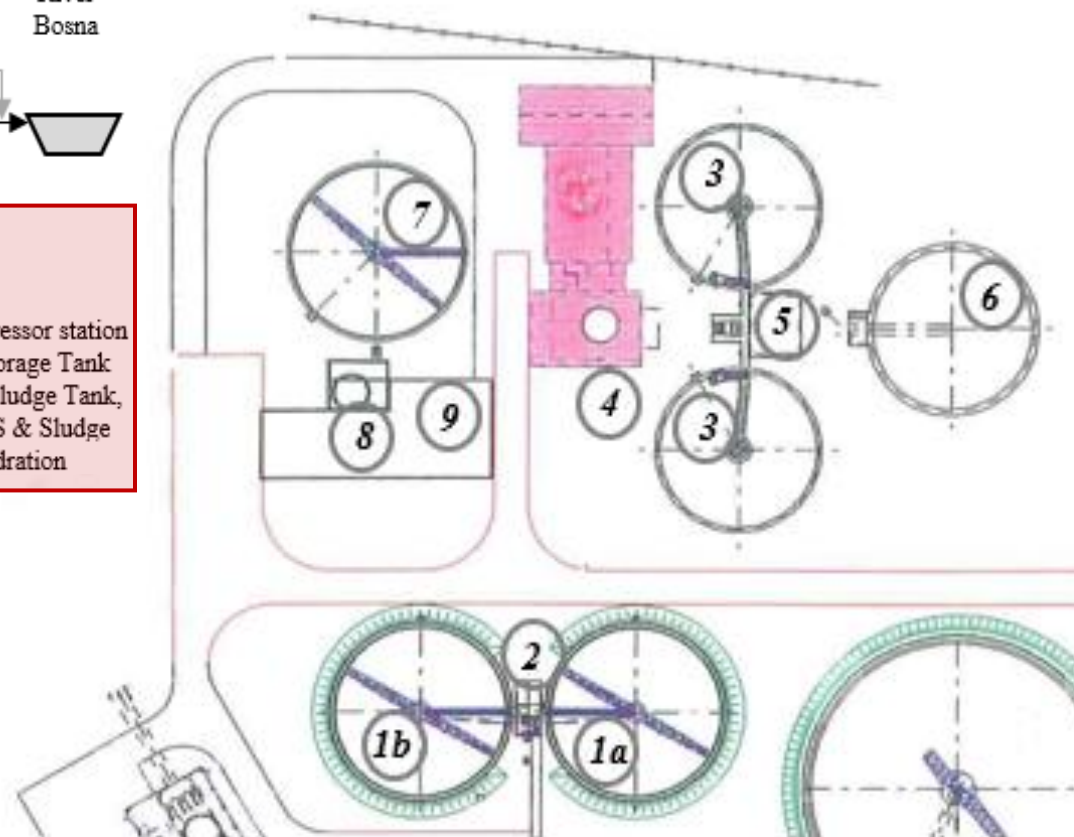


Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina



1a – MIXED SLUDGE TANK
 1b – SLUDGE THICKENER
 2 – THICKENED SLUDGE PS
 3 – SLUDGE DIGESTER (2 pieces)
 4 – BOILER & GENERATOR ROOM

5 – GAS COMPRESSOR STATION
 6 – GAS STORAGE TANK
 7 – DIGESTED SLUDGE TANK
 8 – SLUDGE PUMPING STATION
 9 – SLUDGE DEHIDRATION



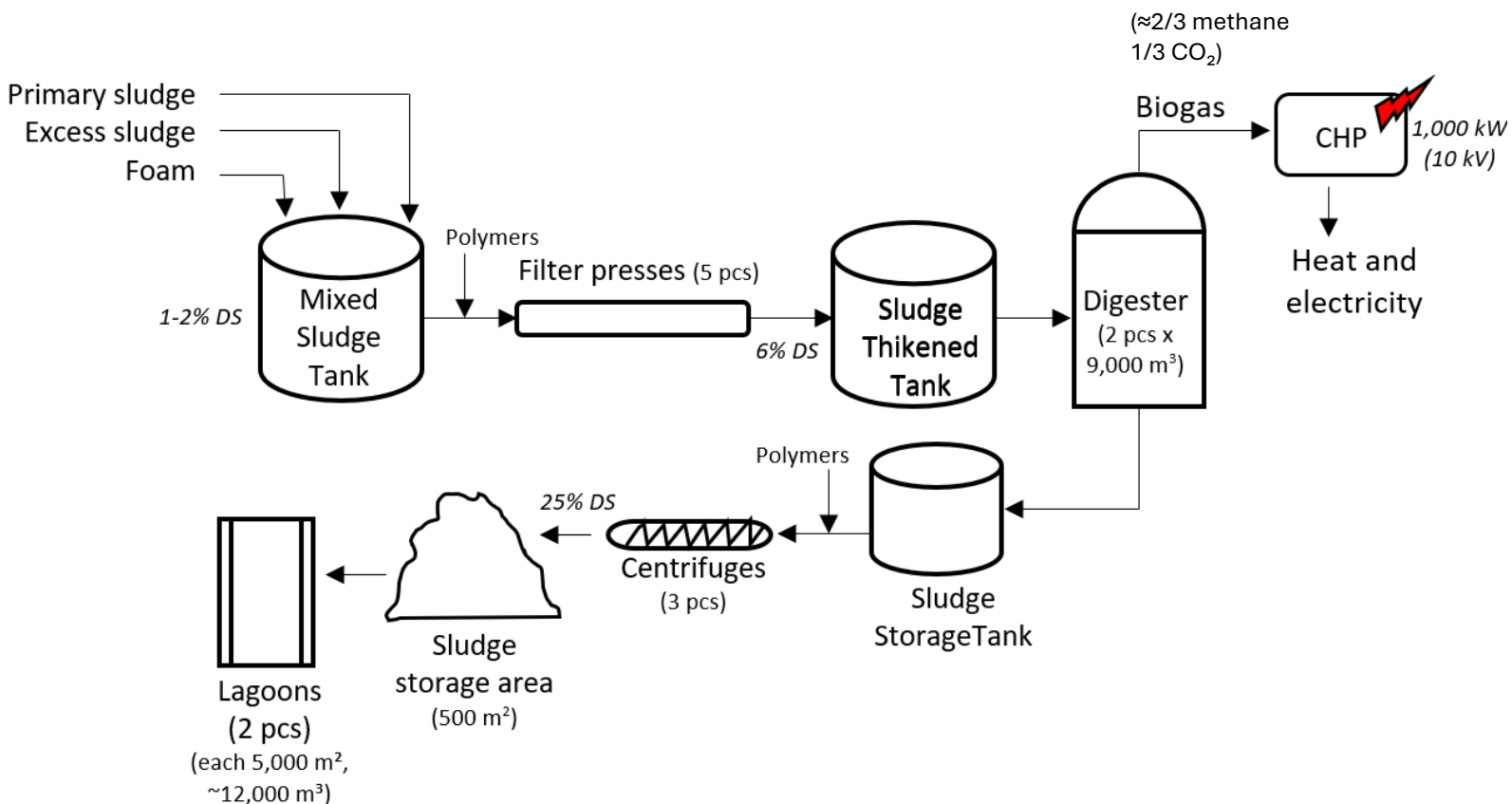
The complete sludge treatment process consists of:

Thickening

Digestion

Final dehydration

Final sludge disposal



Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina



Mixed sludge tank, digesters and gas storage tank

**Temporary storage of
dehydrated sludge**

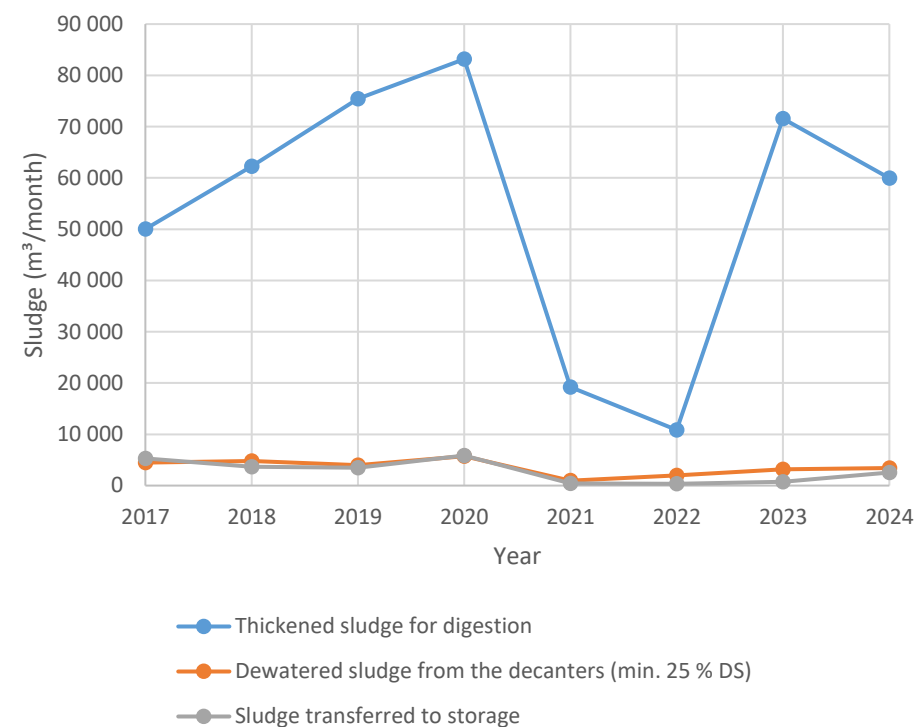


**Current final destination of the
sludge (Lagoons, 2 pcs)**

Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina

How much sludge is produced?

Year	Thickened sludge for digestion m ³ /month	Dewatered sludge from centrifuges (min. 25 % DS) m ³ /month	Sludge transferred to storage m ³ /month
2016	0	3,924	3,924
2017	50,024	4,500	5,272
2018	62,240	4,802	3,659
2019	75,440	3,997	3,474
2020	83,160	5,727	5,864
2021	19,180	958	432
2022	10,840	1,999	348
2023	71,580	3,170	744
2024	59,960	3,420	2,528
Total (m³) :	432,424	32,497	26,245



Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina

The quality of the sludge?

Par.	Unit	2017 (a)	2020 (b)	2020 (c)	2021 (d)	2022 (c)	2023 (c)
DM	%	19.4	24.6	93.2	26.7	86.1	91.4
TOC	mg/kg		297,977*	8.3		7.11	7.1
OM	mg/kg			45.3	9.1	50.2	31.2
pH		7.2		5.3	7.3	6.7	6.7
TN	mg/kg		9,663*	0.82	0.17	0.15	0.15
TP	mg/kg			0.33	0.09	0.02	0.02
Cd	mg/kg	3.8	1.2	1.0	0.6	1.1	1.0
Cu	mg/kg	237	187.6	0.7	108.9	158	142.6
Ni	mg/kg	27	35.7	0.3	63.9	30.1	22.2
Pb	mg/kg	68	65.8	0.4	73.9	68.3	67.2
Zn	mg/kg	1,050	2,676.7*	1.9	139.2	213.1	234.2
Hg	mg/kg	1.5	2	1.1	<0.5	1.1	1.1
Cr	mg/kg	41	101.2	1.2	140.3	215.2	152.2

- a) NUA – Umweltanalytik GmbH, Austria,
b) Kemis BH, d.o.o. & Dekonta BH d.o.o., Sarajevo, B&H,
c) Inspekt RGH, Sarajevo, B&H,
d) Dvokut pro d.o.o. Sarajevo, B&H,

* Values that come out of the standard framework should be taken into analysis with special attention

DM – Dry matter
TOC - Total Organic Carbon
OM – Organic matter
TN – Total Nitrogen
TP – Total Phosphorus
Cd - Cadmium
Cu - Copper
Ni - Nickel
Pb - Lead
Zn - Zinc
Hg - Mercury
Cr - Chromium

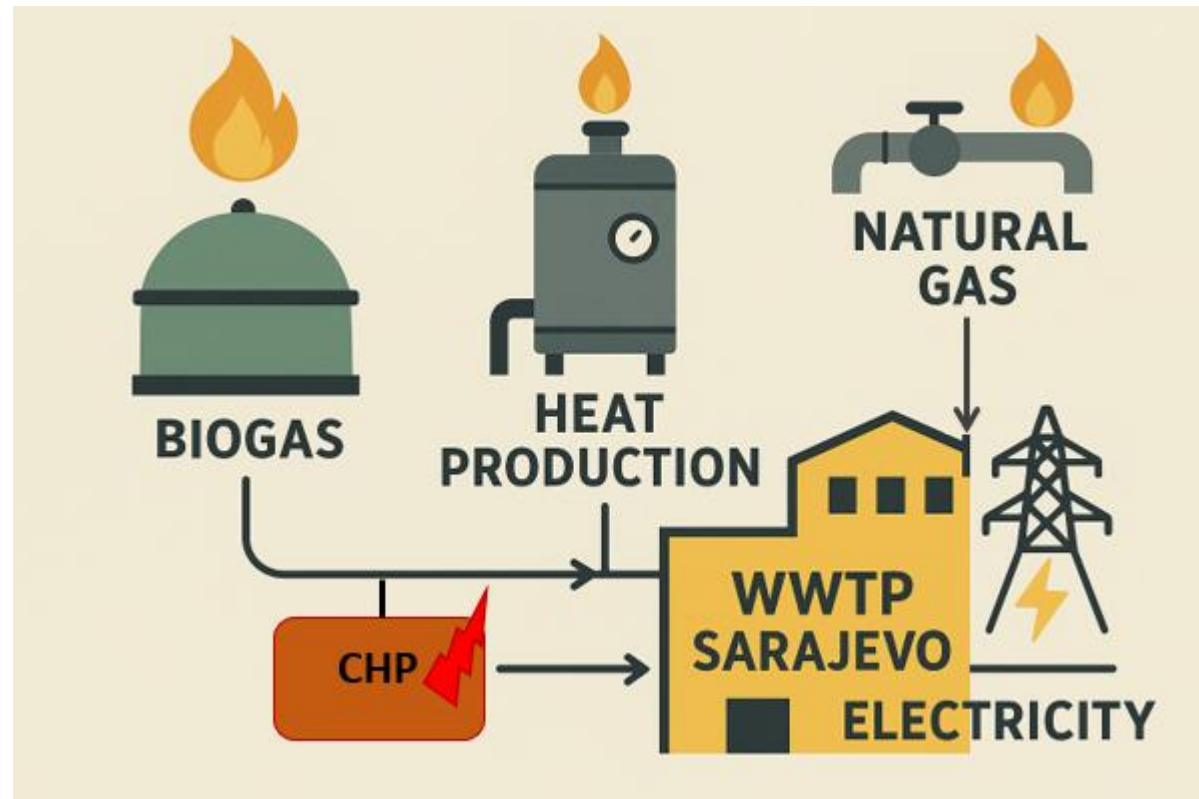
Year	Parameters			
	DS (%)	TS (g/L)	TIS (g/L)	TVS (g/L)
2018	27.1	338.4	154	184.5
2019	27.8	280	95.8	185
2020	28.5	292.7	108.6	184
2021	26	338.4	113.7	224.8
2022	23	226.9	69.1	158.3
2023	27.8	294.4	102.2	201.3
2024	27	289	91.3	194.4

Results (digester):

- CH₄=64-72 % (of 100%)
- CO₂=27,5-35 % (od 100%)
- 1 % other trace gases
- H₂S=max.106-210 ppm

Energy sources?

- A. Biogas (own production from digested sludge)
 - Electricity (own production through CHP)
 - Thermal heating of facilities and processes (own production through the boiler room)
- B. Natural gas (public gas network *KJKP Sarajevogas*)
- C. Electricity (public power network, *JP Elektroprivreda d.d. Sarajevo*)



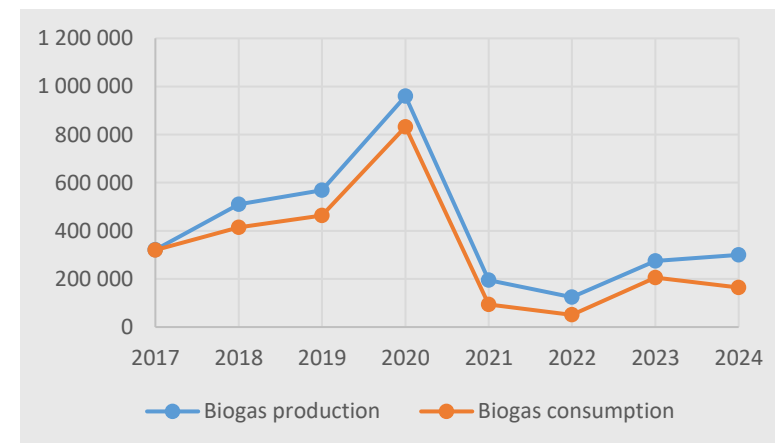
- Gas line established since July 2017

Production and consumption of biogas?

- Biogas is produced in digesters through alkaline, mesophilic digestion;
- The sludge retention time in digesters is approximately 25–30 days.
- Biogas composition: about 2/3 methane, 1/3 carbon dioxide, with other gases present in trace amounts below 1%.
- Biogas is used as fuel to partially meet the plant's heat demand and to operate the CHP unit.
- The difference between the volume of biogas produced and consumed is used for mixing the digester contents.
- The CHP unit has not been working since June 2020 due to engine damage. Biogas is not being used for energy production. Engine repair activities are in progress.



Year	Biogas production (m ³ /year)	Biogas consumption (m ³ /year)
2017	321,758	320,627
2018	510,644	414,851
2019	568,284	463,868
2020	959,454	832,471
2021	195,156	94,324
2022	124,334	50,717
2023	274,155	205,272
2024	299,500	164,024
Sum:	3,253,285	2,546,154

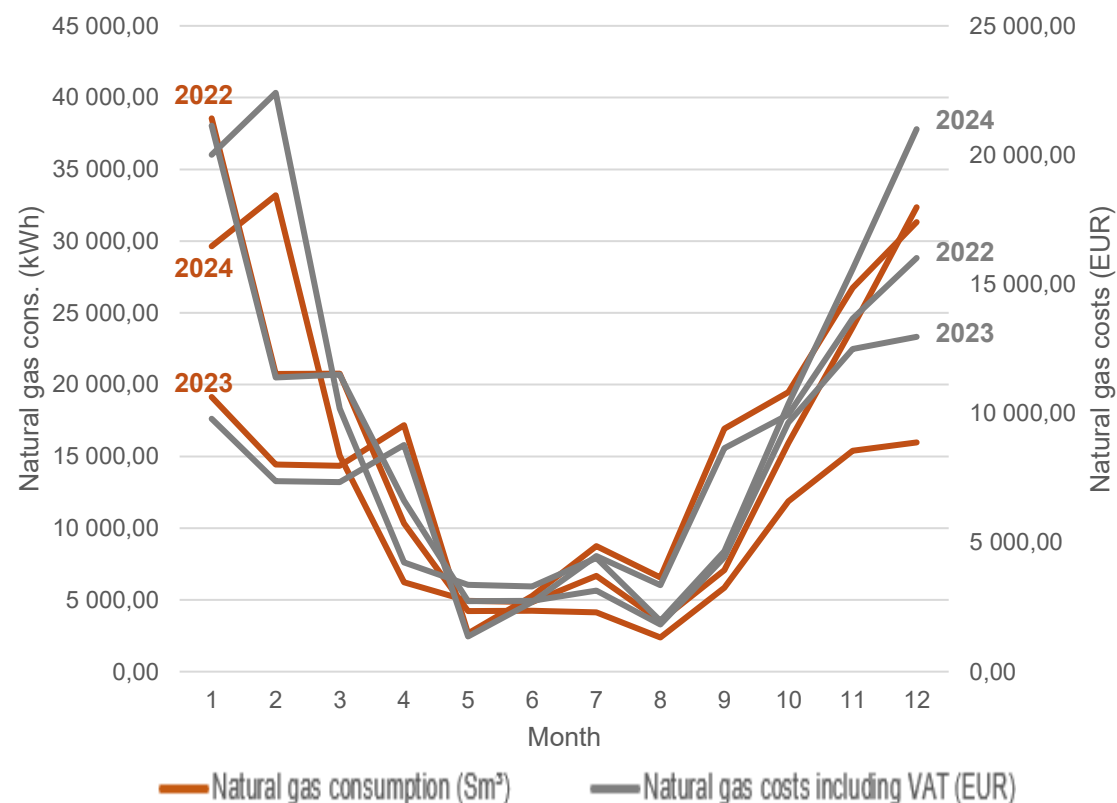


Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina

Natural gas consumption and costs including VAT.

Month	2022		2023		2024	
	Natural gas consumption (Sm ³)	Natural gas costs including VAT (EUR)	Natural gas consumption (Sm ³)	Natural gas costs including VAT (EUR)	Natural gas consumption (Sm ³)	Natural gas costs including VAT (EUR)
Jan	38,552.54	9,785.55	19,140.17	21,136.31	29,640.25	20,011.93
Feb	20,753.02	7,373.92	14,423.38	11,387.54	33,193.44	22,407.15
Mar	20,773.78	7,335.86	14,348.95	11,499.05	15,056.26	10,183.28
Apr	10,319.12	8,776.49	17,166.82	6,621.49	6,221.83	4,229.43
Mai	4,227.22	1,361.12	2,662.36	2,733.26	4,923.31	3,354.02
Jun	4,241.09	2,696.63	5,274.61	2,742.57	4,848.03	3,303.52
Jul	4,132.66	4,472.54	8,748.28	3,141.20	6,668.02	4,402.23
Aug	2,380.40	3,352.98	6,558.43	1,824.73	3,537.15	1,965.69
Sept	5,839.04	8,652.31	16,923.91	4,424.83	7,066.89	4,662.44
Oct	11,857.58	9,952.99	19,468.05	9,635.18	15,935.04	10,356.12
Nov	15,394.50	13,666.88	26,732.42	12,495.39	24,003.16	15,584.06
Dec	15,966.86	16,013.63	31,322.66	12,956.47	32,368.53	21,004.49
Sum:	154,437.81	93,440.90	182,770.04	100,598.01	183,461.91	121,464.37

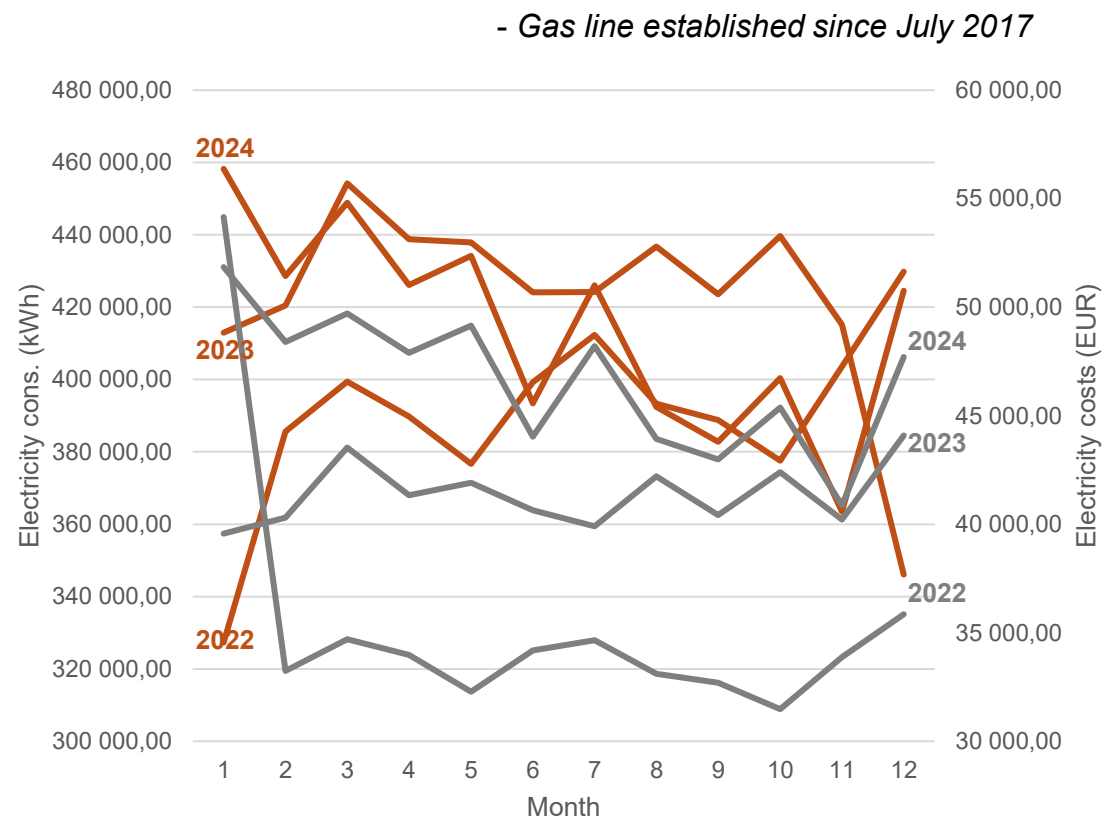
- Gas line established since July 2017



Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo Bosnia and Herzegovina

Electricity consumption and costs including VAT.

Month	2022		2023		2024	
	Electricity consumption (kWh)	Electricity costs incl. VAT (EUR)	Electricity consumption (kWh)	Electricity costs incl. VAT (EUR)	Electricity consumption (kWh)	Electricity costs incl. VAT (EUR)
Jan	327,291.60	54,151.08	412,935.20	39,566.01	458,237.60	51,848.65
Feb	385,651.20	33,238.71	420,439.20	40,302.22	428,622.00	48,399.50
Mar	399,459.60	34,695.99	454,246.40	43,535.73	448,841.60	49,705.97
Apr	389,785.60	33,969.99	438,784.00	41,333.62	426,167.60	47,901.41
Mai	376,670.80	32,284.32	437,948.40	41,908.99	434,226.40	49,155.37
Jun	399,226.00	34,179.18	424,120.80	40,636.94	393,423.20	44,036.93
Jul	412,312.40	34,649.30	424,159.60	39,906.37	426,037.20	48,209.59
Aug	393,316.00	33,110.05	436,763.20	42,204.56	392,423.60	43,928.31
Sept	388,764.00	32,688.78	423,578.00	40,413.65	382,812.00	42,987.59
Oct	377,544.80	31,476.68	439,710.80	42,392.47	400,357.20	45,370.44
Nov	403,540.40	33,877.74	415,128.00	40,216.82	363,462.40	40,879.16
Dec	429,821.60	35,853.97	346,065.60	44,089.35	424,574.80	47,706.00
Sum:	4,683,384.00	424,175.80	5,073,879.20	496,506.74	4,979,185.60	560,128.92



What are the next steps and future improvements?

- ❖ Inclusion of an item for payment of waste water treatment
- ❖ Repair of the CHP unit (engine failure)
- ❖ Finding an adequate solution and financing method for the final disposal of sludge
- ❖ ...



Published papers in journals and conferences related to the issue of wastewater and sludge treatment at the WWTP Sarajevo:

1. Džubur, A., Dizdarević, A., Busuladžić, A., Delija, S., Serdarević, A. (2024). Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo. In: Ademović, N., Akšamija, Z., Karabegović, A. (eds) Advanced Technologies, Systems, and Applications IX. IAT 2024. Lecture Notes in Networks and Systems, vol 1143. Springer, Cham https://doi.org/10.1007/978-3-031-71694-2_5
2. Džubur, A., Schütze, M., Bibović, A. (2024). SAmPSONS Tool: Simulating Material Flows in the Sarajevo Sewer System for Investment Preassessment and Reconstruction. In: Ademović, N., Akšamija, Z., Karabegović, A. (eds) Advanced Technologies, Systems, and Applications IX. IAT 2024. Lecture Notes in Networks and Systems, vol 1143. Springer, Cham. https://doi.org/10.1007/978-3-031-71694-2_12
3. Džubur A., Serdarević A. and Šuvalija S. "Modelling Steps for Dynamic Simulation of Wastewater Treatment Processes", 13th Days of BHAAAS IN Bosnia and Herzegovina - Sarajevo 2022, 23-26 June 2022, Bosnia and Herzegovina.
4. Džubur, A. and Serdarević, A. "The Importance of Applying an Appropriate Approach to Modelling Wastewater Treatment Plants", Coupled Systems Mechanics, Vol. 11, No. 2 (2022), pp. 121-132, 2022 - DOI: <https://doi.org/10.12989/csm.2022.11.2.121>, Copyright © 2022 Techno-Press, Ltd., Ltd., <http://www.techno-press.org/?page=container&journal=csm&volume=11&num=2> ISSN: 2234-2184 (Print), 2234-2192 (Online).
5. Serdarević A., Džubur A., "Importance and Practice of Operation and Maintenance of Wastewater Treatment Plants", Advanced Technologies, Systems, and Applications III, Springer Nature Switzerland AG 2019.
6. A. Džubur i A. Serdarević, "Kontrola i održavanje PPOV – Primjer PPOV Butile, Sarajevo, BiH", u 5. Konferencija "Održavanje - Maintenance 2018", Zenica, 10-12 Maj, Bosna i Hercegovina, 2018.

Treatment and Disposal of Sludge at the Municipal Wastewater Treatment Plant of Sarajevo
Bosnia and Herzegovina

Thank you for your attention!

