

# Analysis of the effectiveness of greywater treatment in the coagulation process

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## Introduction

The total freshwater resources available in Poland are relatively small and characterised by seasonal and regional variability. They amount to approximately 1,600 m<sup>3</sup> per person per year, which is below the water stress level (1,700 m<sup>3</sup>). In Europe, only the Czech Republic, Cyprus and Malta have smaller water resources than Poland [2]. Treated greywater can be a source of water for reuse in buildings. The percentage of greywater that can be reused is approximately 75% of the total amount of water used in a building [1]. To make this possible, it is necessary to install a collection and treatment system and a dual installation. After preliminary mechanical treatment, greywater can be effectively treated by coagulation.

## Material and methods

In order to estimate greywater resources, balance calculations were made for the unit production of wastewater for a typical residential building, broken down by sanitary facilities. The structure of greywater is as follows: 8.3% from washbasins, 54% from bathtubs, and 12.8% from laundry. Greywater collected from household sanitary facilities (washing machine – 8.5 L, washbasin – 5.5 L, bathtub – 36 L) was mixed in fixed proportions. The mixed wastewater was filtered through a 100 µm string filter and a sand filter at a speed of 5 m/h. The wastewater was then subjected to a coagulation process. The effectiveness of 7 coagulants was assessed for doses ranging from 0.1 to 0.25 mL/L. After the coagulation process, sedimentation (t=10 min) and rapid filtration (v=5 m/h) were carried out.

## Results and discussion

Six test series of the coagulation process were presented, using two coagulants and four doses (Table 1, Figs. 1 and 2).

Table 1 Significant parameters of raw greywater

Parameter	Test series					
	S1	S2	S3	S4	S5	S6
pH	7.980	8.224	8.122	7.106	7.190	7.123
Turbidity [NTU]	101	69.8	164.0	151	47.8	44.0
COD Mn [mg/L]	46.4	64.0	80.0	57.6	40.0	36.0
COD [mg/L]	785	495	224	527	310	224

Greywater is characterised by a highly variable composition. Its high turbidity (44-164 NTU) and high organic content prevent its reuse without treatment processes. Compared to the literature data, its quality was characteristic of light greywater [3].

The data presented in Figs. 1 and 2 indicate that the quality of the treated greywater depended on the type and dose of coagulant. In the case of the PAX 18 coagulant, the use of a higher dose allowed better results to be achieved, but only in the case of S1 for a dose of 0.25 mL/L was the turbidity after treatment lower than 10 NTU (milestone). In the case of the Neofloc D804 coagulant, for all series, the best turbidity removal effect was achieved with a dose of 0.2 mL/L. As can be seen in Figure 2, COD Mn removal was not as effective, which indicates that the organic compounds were mainly in dissolved form.

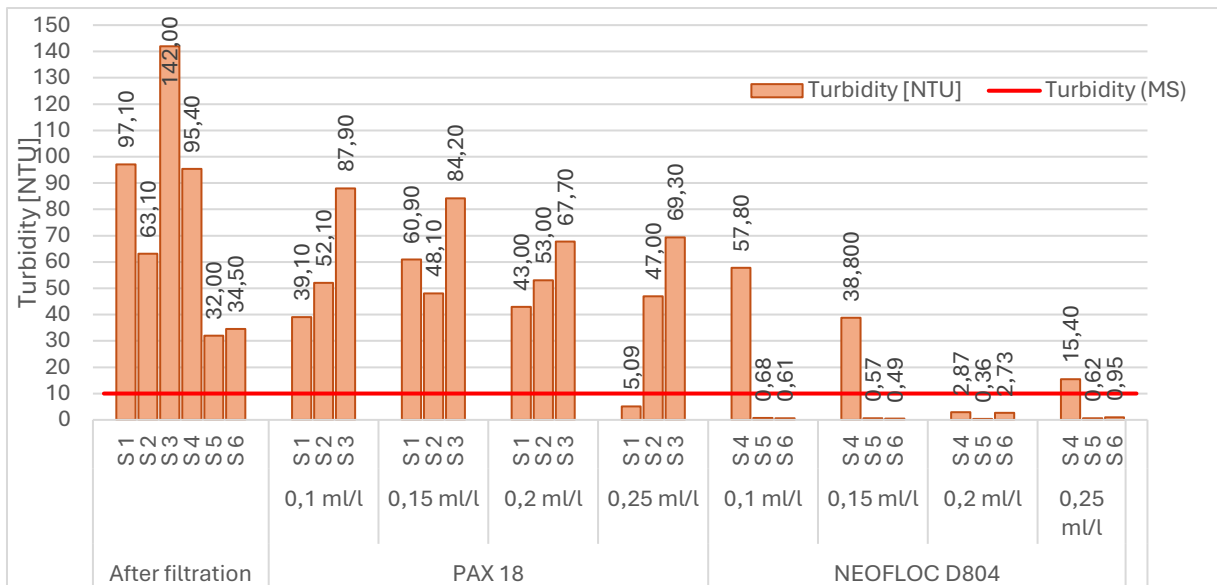


Fig. 1 Turbidity of grey wastewater after filtration and coagulation

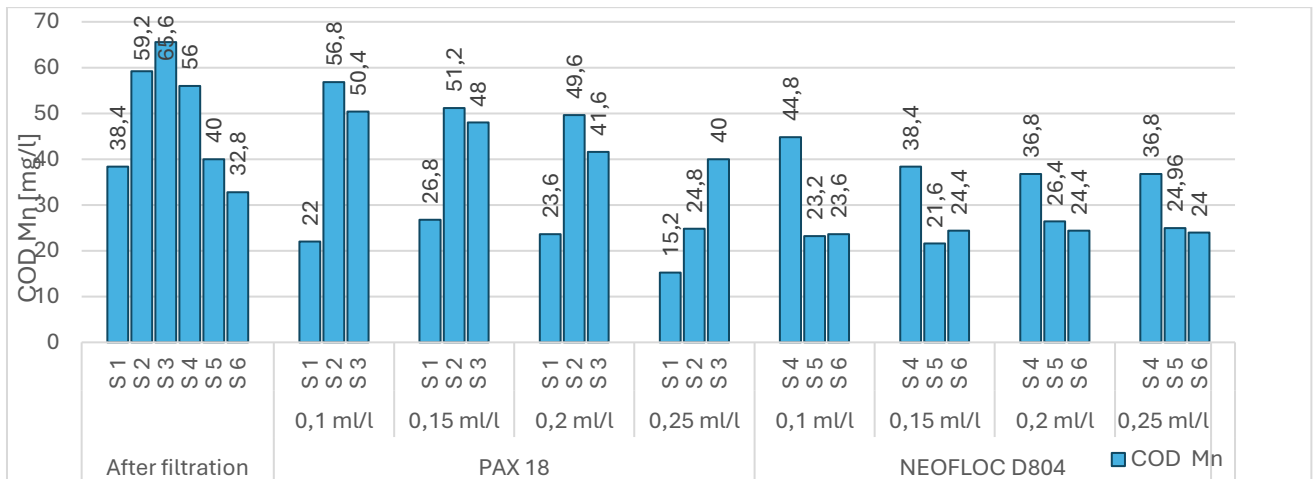


Fig. 2 COD Mn of grey wastewater after filtration and coagulation

## Conclusion

Based on the research conducted, it was concluded that the coagulation should be one of the unit processes prior to the disinfection.

## References

1. Chudzicki J., Sosnowski S.: Instalacje wodociągowe, projektowanie, wykonanie, eksploatacja, Wydawnictwo Seidel-Przywecki Sp. z o.o., Warszawa 2009 r.
2. <https://raportsdg.stat.gov.pl/2020/cel6.html>
3. Shaikh, Irshad N., and M. Mansoor Ahammed. "Quantity and quality characteristics of greywater: a review." *Journal of environmental management* 261 (2020): 110266.

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