

Development of an Innovative Grease Interceptor to Remove Fat, Oil and Grease (FOG) from Wastewater Generated by Food Service Establishments

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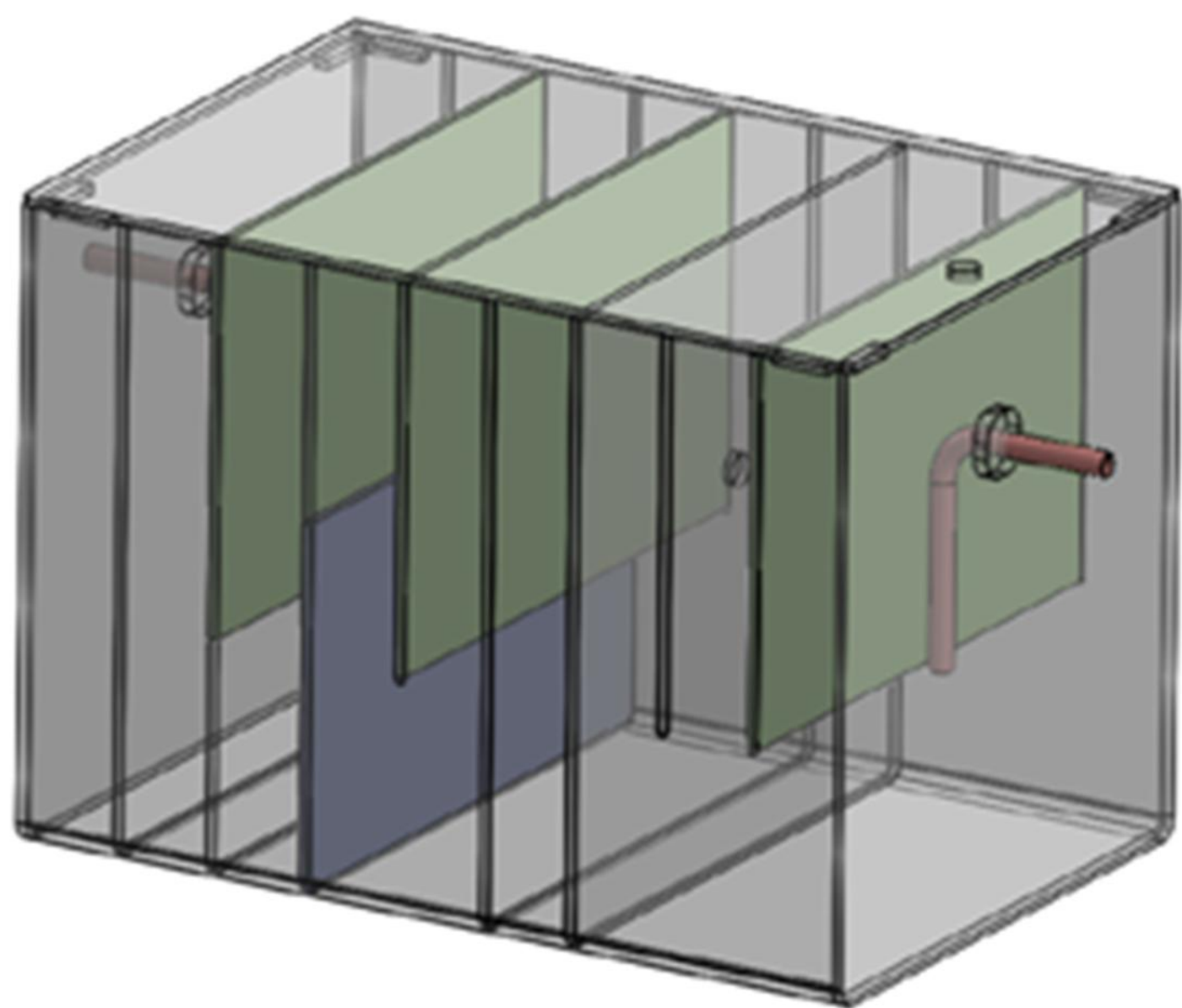
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Introduction

- ❖ FOG waste is generally generated from food service establishments (FSEs)/ household kitchens and made up of FAs, hydrocarbons, soaps, lipids and waxes. FOG is believed to cause over 50 to 70% of sewer blockages worldwide. The UK, USA and Australia spend £100 million, \$25 billion and \$100 million per annum to clear them.
- ❖ Separation of FOG through a GI system is a common practice used by commercial FSEs. Automatic appliances like dishwashers are likely to have a significant influence on FA profile and producing highly emulsified FOG particles with diameters smaller than 150 μm .
- ❖ Using a dishwasher in the cleaning process significantly breaks down FOG particles, with 50% being $\leq 7 \mu\text{m}$ —17 times smaller than particles from handwash sinks (HS).
- ❖ kitchens equipped with dishwashers released up to 80% of FOG particles $\leq 45 \mu\text{m}$, disposing of very high concentrations of FOG (1.8 to 9.6 g/L) into the sewer networks.
- ❖ The aim of this study was to **develop a novel GI design** integrated with physical and chemical treatment, featuring multiple short baffles and various baffle wall configurations to enhance FOG removal efficiency.

Materials and methods

- ❖ A lab-scale dual-compartmental GI unit (60x30x40 cm³) was fabricated with acrylic and configured with **five baffle-wall arrangements**, designed to accommodate a maximum of 72 L wastewater sample.
- ❖ **Three types of fats and oils** were used: a) cooked canola oil (CO), b) chicken fat (CF) and c) a mixture of CO, CF and smashed cooked rice (CO+CF+Rice).
- ❖ **Two types of movable short baffle walls** were introduced: short baffle type L (lower, projecting from the bottom of the GI) and short baffle type U (upper, projecting from the top of the GI) while a fixed baffle F divided the separator into two compartments.
- ❖ Two different cleaning processes were undertaken: a) **handwash-sink** wash (HSW) and b) **dishwasher** wash (DWW).

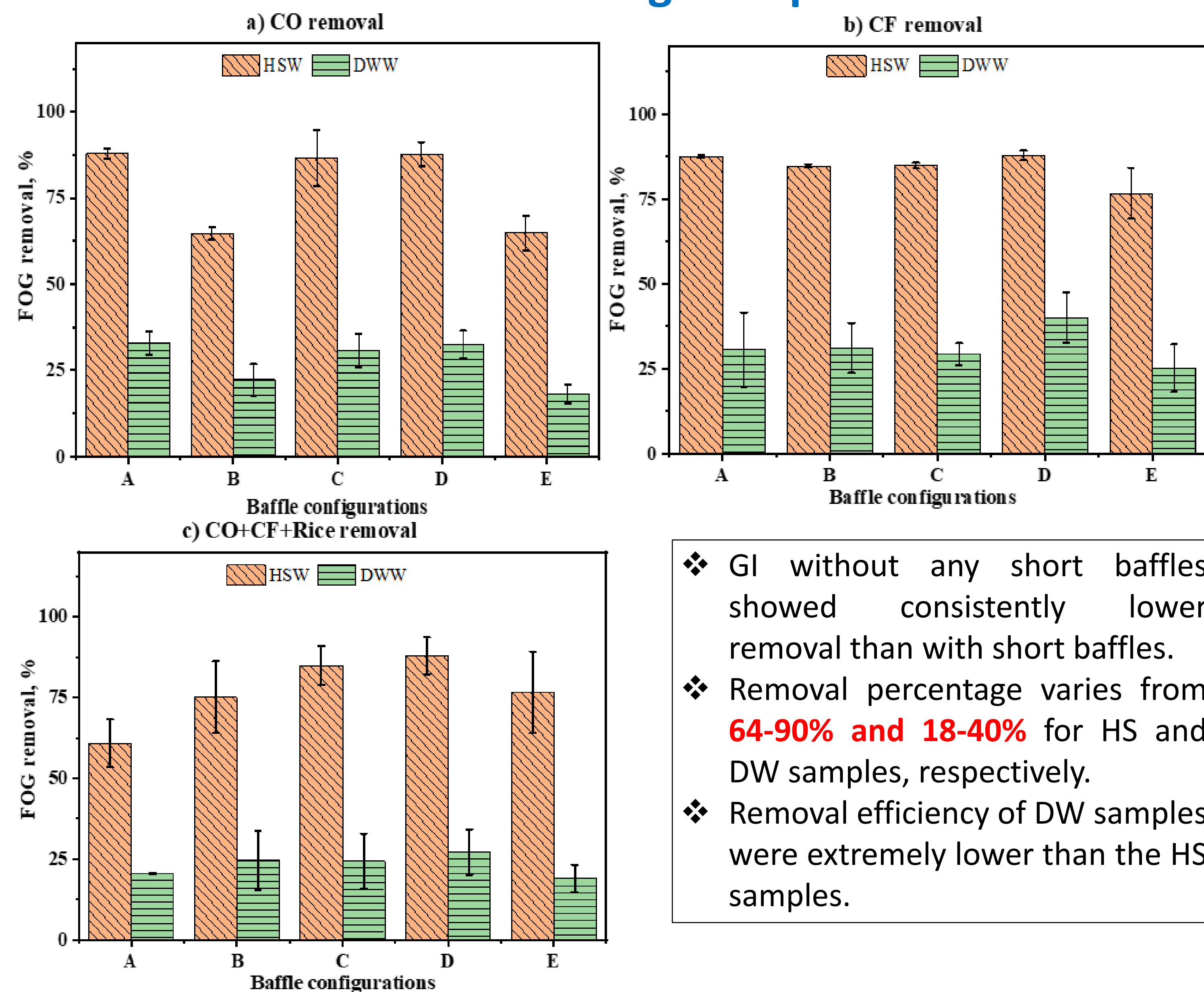


- ❖ Particle size distribution: Malvern Mastersizer-Laser 3000.
- ❖ FOG concentration: EPA method.
- ❖ Fatty acid profiling: AOAC method 996.06.
- ❖ Metal analysis: ICP-MS.
- ❖ Al₂(SO₄)₃.14H₂O (alum) was used using jar test apparatus.

Figure 1: The standard baffle configuration for the novel GI

Results and discussions

FOG removal efficiencies using GI separator



- ❖ GI without any short baffles showed consistently lower removal than with short baffles.
- ❖ Removal percentage varies from **64-90% and 18-40%** for HS and DW samples, respectively.
- ❖ Removal efficiency of DW samples were extremely lower than the HS samples.

Figure 2: FOG removal efficiencies with respect to different baffle wall arrangements.

Effect of dose of coagulant

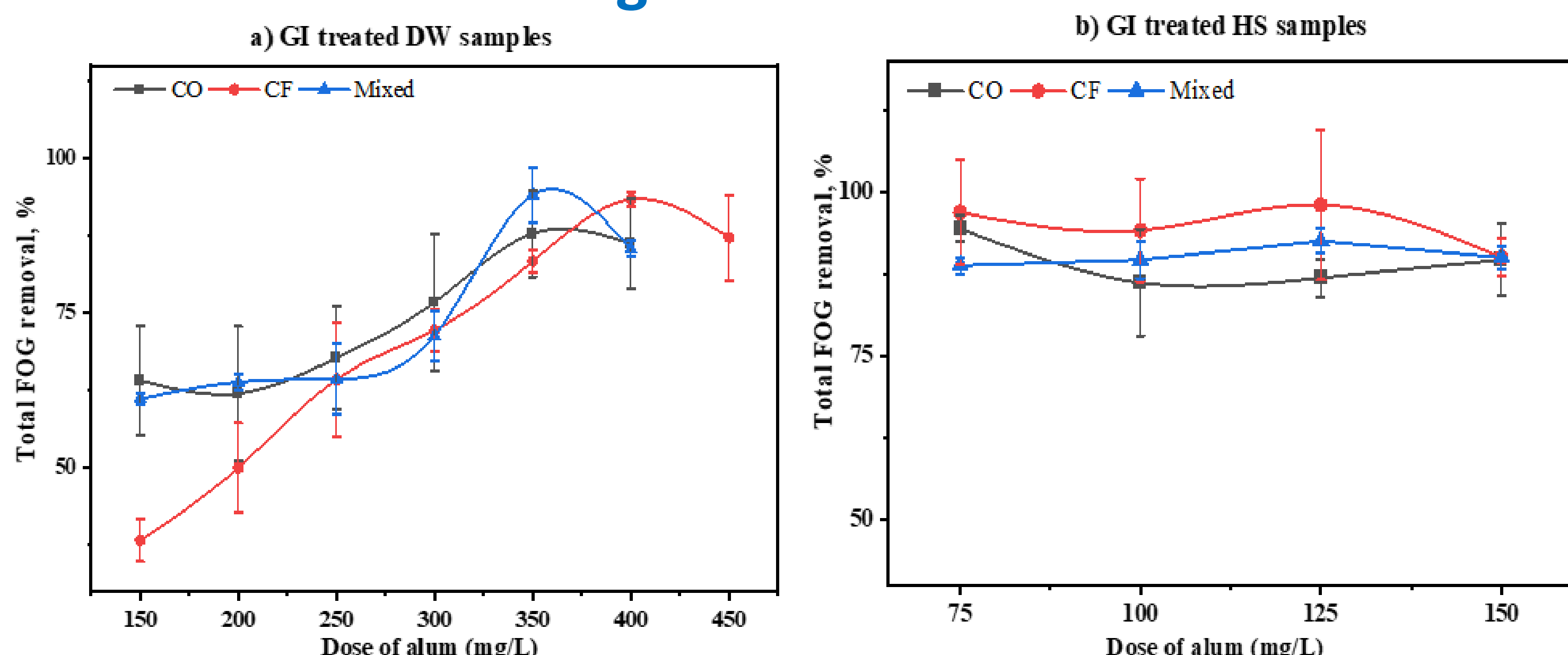


Figure 3: Impact of dose of alum: a) and b) for GI treated DW and HS samples.

- ❖ CO and mixed (removal-DW): **98% and 97%** at 350 mg/L; CF (DW): **99%** at 400 mg/L
- ❖ CO, CF and mixed (removal-HS): **93-98%** at 75-150 mg/L

Impact of inflow rate and influent temperature

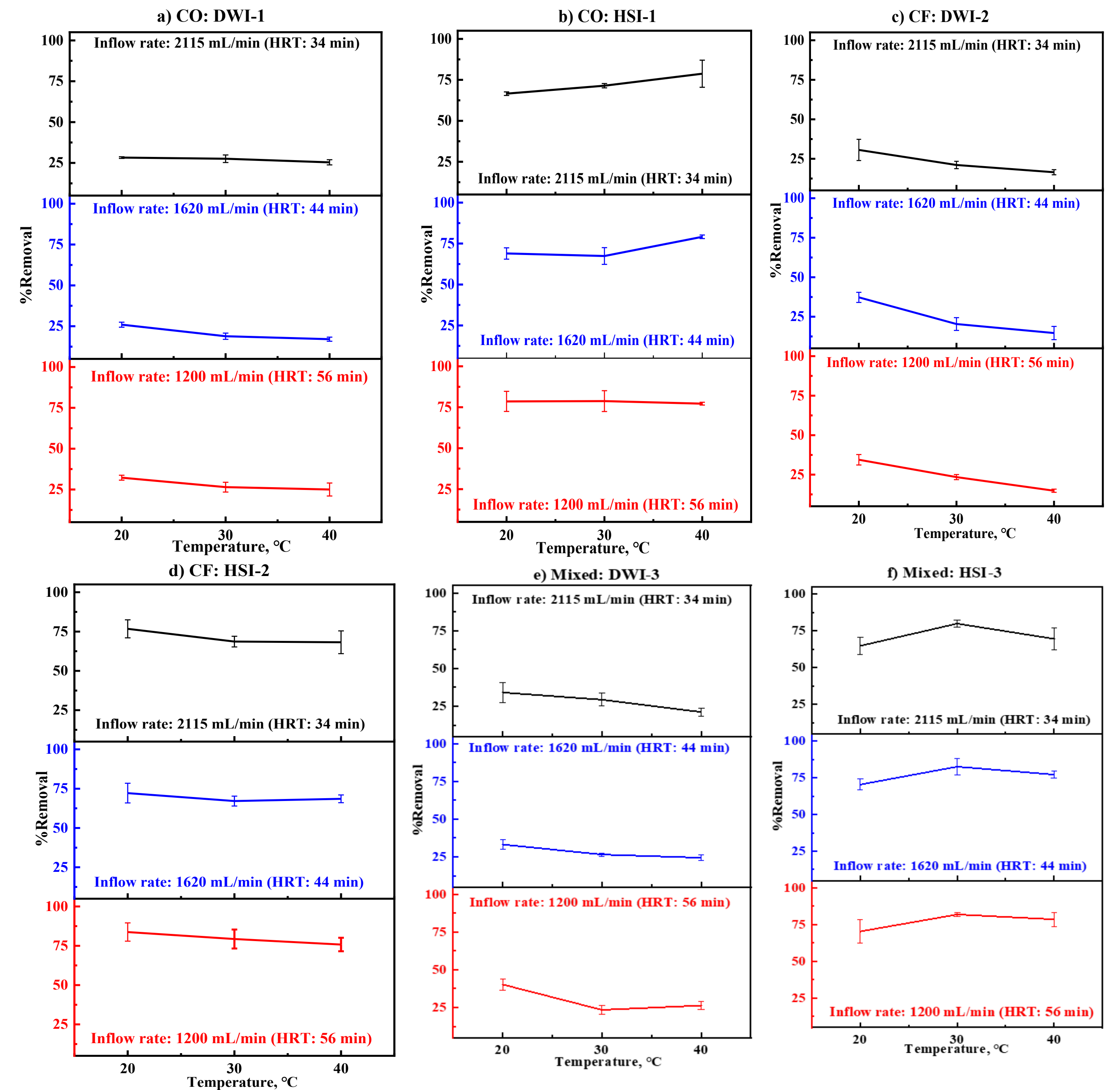
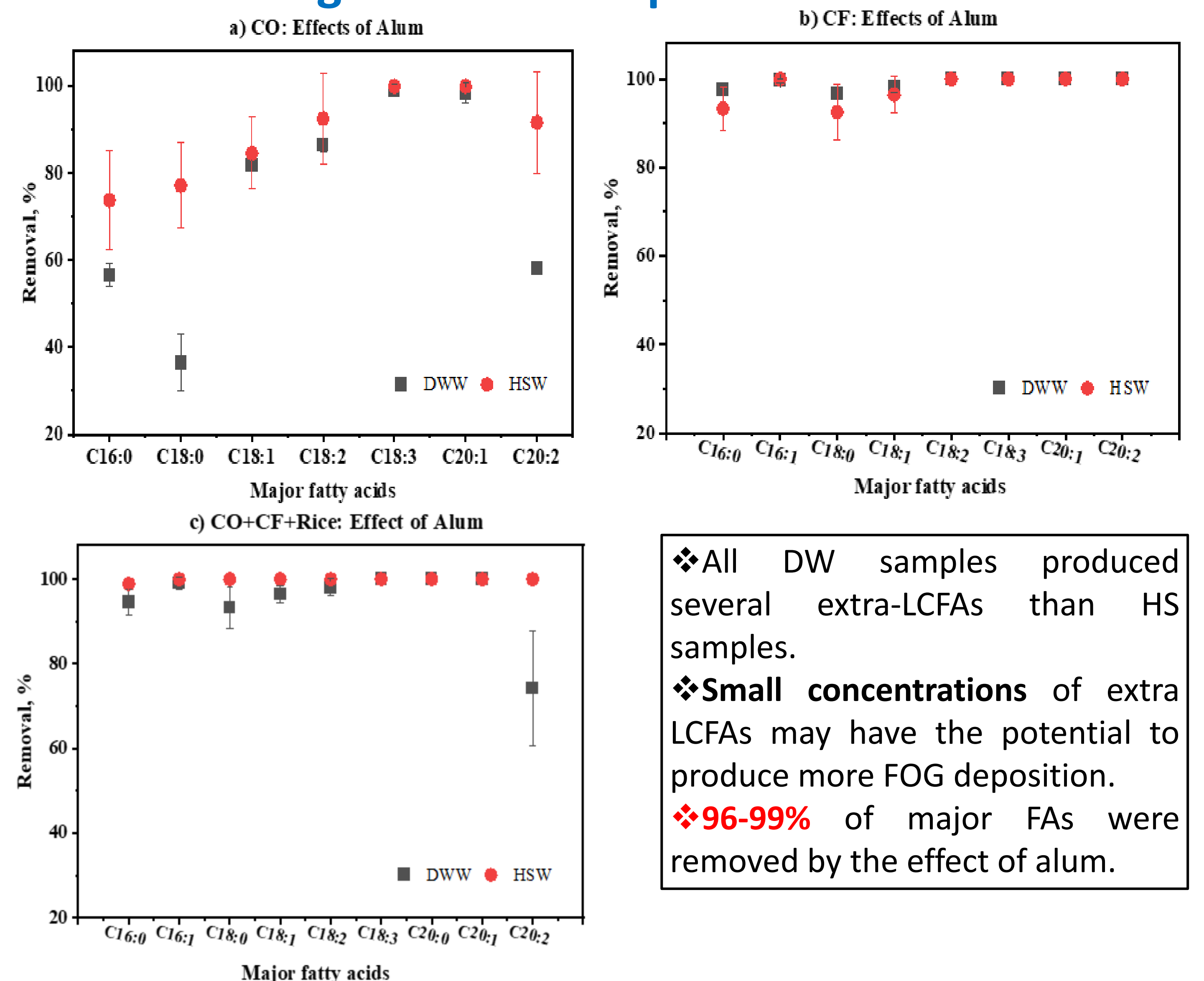


Figure 4: The efficiency of FOG removal with respect to cleaning processes, inflow rates and temperatures.

- ❖ CO: Optimum removal=**32.5%** at a rate of **1200 mL/min** at **20°C**
- ❖ CF: Highly depends on temperature. Max: **31-37%** removal at **20°C**.
- ❖ Mixed: Optimum removal=**40%** at a rate of **1200 mL/min** at **20°C**

Effect of coagulation on FA profile



- ❖ All DW samples produced several extra-LCFAs than HS samples.
- ❖ **Small concentrations** of extra LCFAs may have the potential to produce more FOG deposition.
- ❖ **96-99%** of major FAs were removed by the effect of alum.

Figure 5: The removal of FAs from the three sample types after alum coagulation of the HSW (alum: 100 mg/L) and DWW (alum: 200 mg/L)

Conclusions

- ❖ FOG removal: 88% for HS and 40% for DW effluents (without chemical treatment).
- ❖ Temperature plays a significant role on FOG removal for DW samples.
- ❖ Inflow rate impacts differently on cooking oil and animal fat removal.
- ❖ Max **93%-99%** of removal for DW and HS samples found at a dose of **350-400 and 75-150 mg/L** of alum, respectively.
- ❖ Alum effectively reduced the concentrations of various extra-LCFAs.

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