Microbial Electrolysis Cells Detect Differences in Waste-Activated Sludge Pretreatment Technologies

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Can MECs detect differences in biodegradability?

Microbial electrochemical cells (MECs) effectively **distinguish** between the biodegradability of pretreated **waste activated sludge** (WAS) **centrates**, with alkaline and thermal pretreatments releasing 10-12x more soluble COD vs. the control sample. MECs can identify different biodegradation events and can be used to **establish consumption rates** by anaerobic microorganisms.

Background

Biochemical Methane Potential (BMP) tests are commonly used to evaluate the substrate biodegradability. However, BMPs (1) lack short time resolutions to determine hydrolysis rates or identify different hydrolysis events as they occur and (2) utilize anaerobic digester inoculum that contains residual COD, which can result in overestimating methane production. MECs have the potential to identify COD bioavailability with high time resolution.

Experimental design

WAS pretreatments		
Control	**Pulsed-electric field (PEF)**	
No treatment	OpenCel α-unit at 29-30 kV	
Alkaline	**Thermal**	
pH adjusted to 12 for 24 hours then adjusted to pH 7	Autoclave at 121ºC for 30 minutes and cooled overnight	

Centrifuged and decanted the liquid to obtain the "centrate"
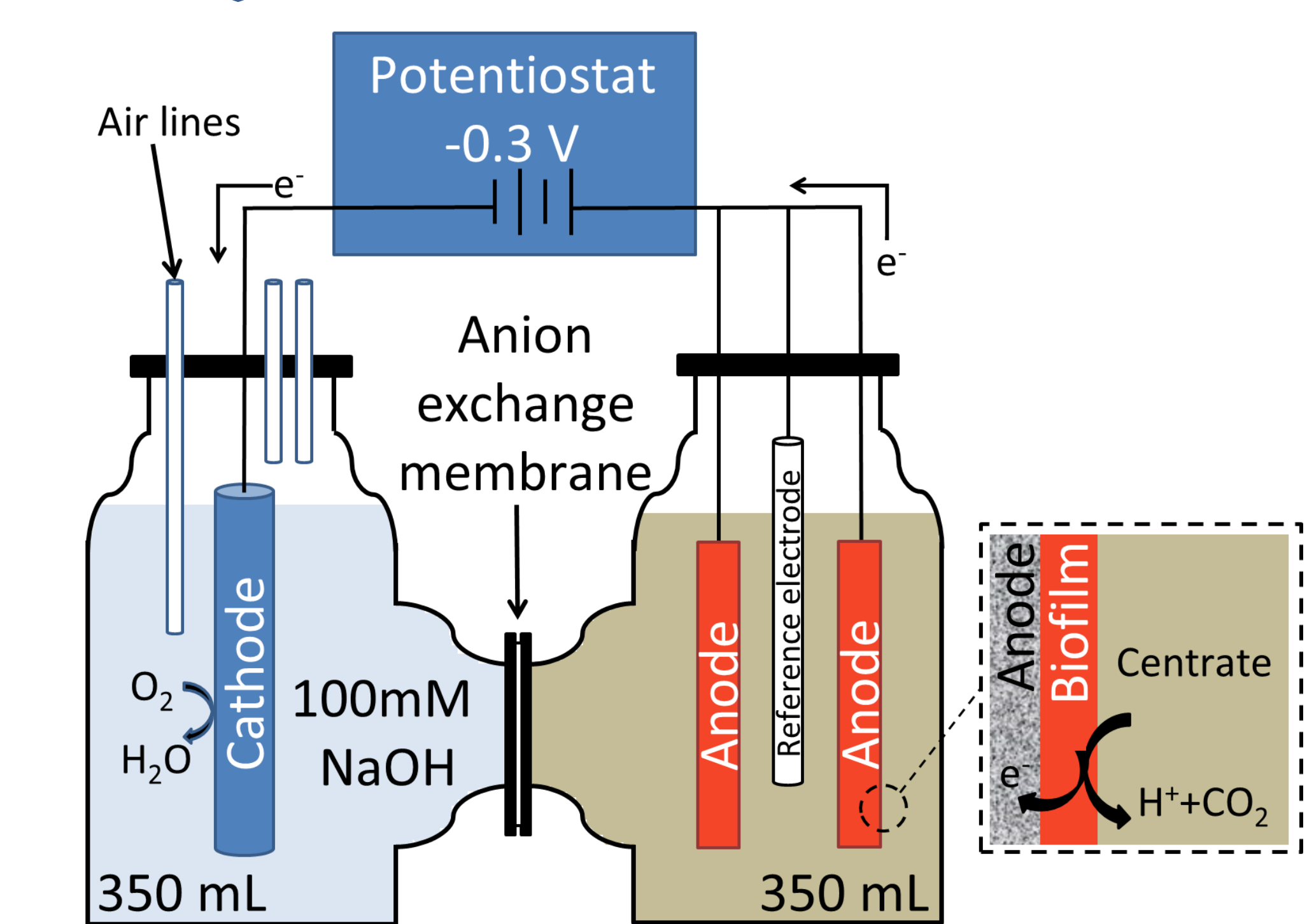
Repeat 3x with PEF and 4x with all other centrates

Measurements include current density, COD, alkalinity, TSS/VSS, pH, ammonium, and volatile fatty acids.
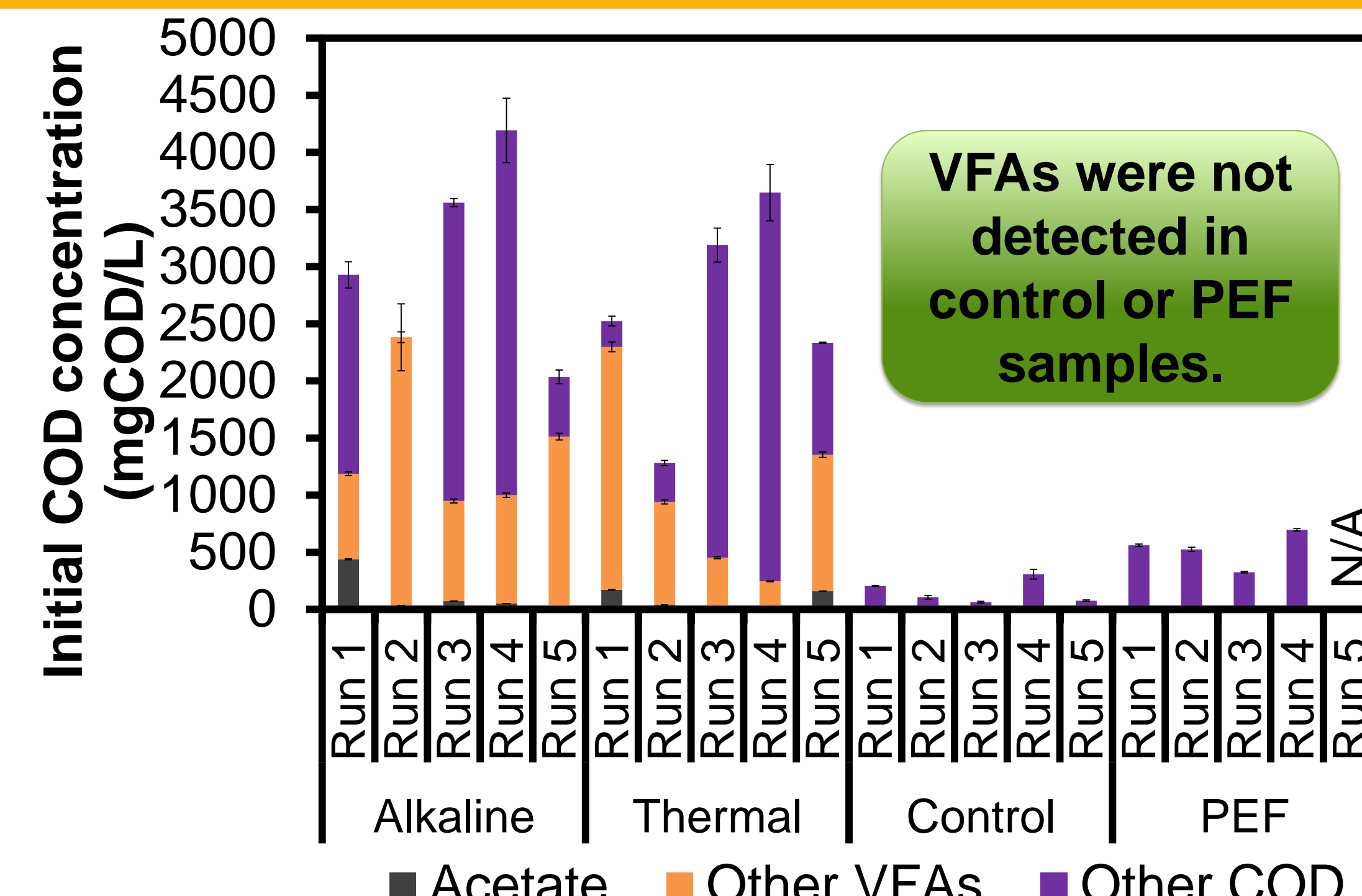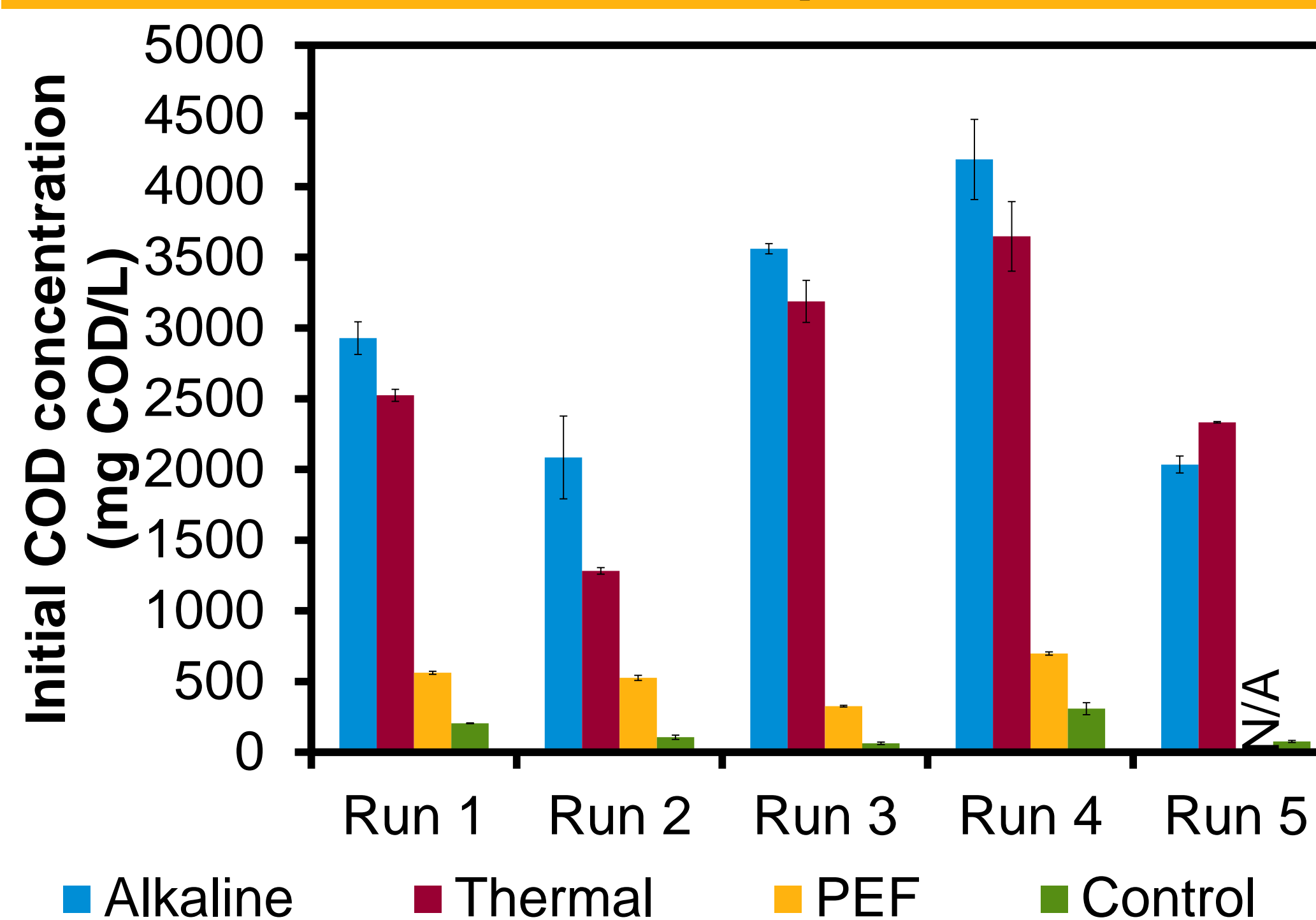
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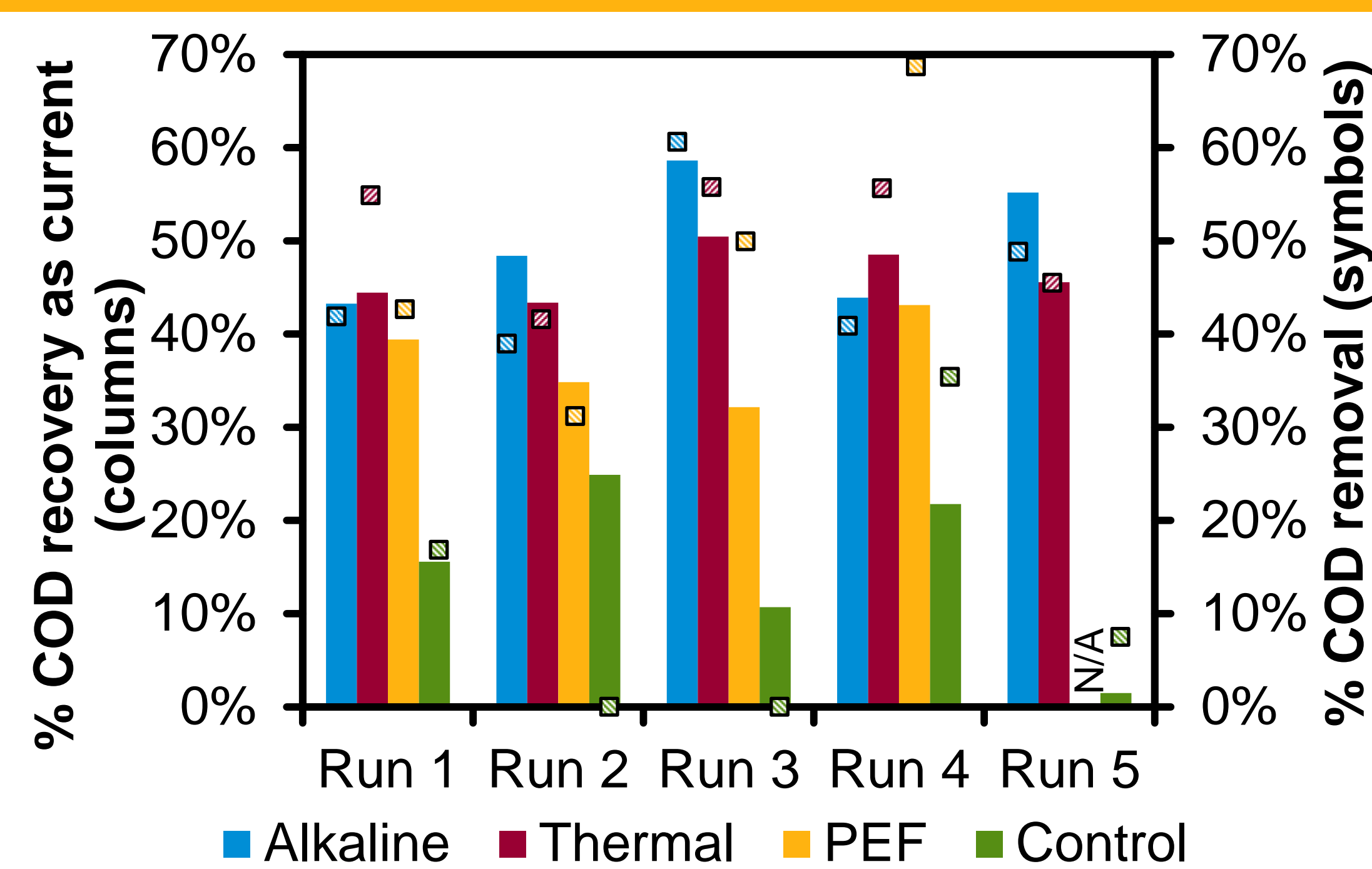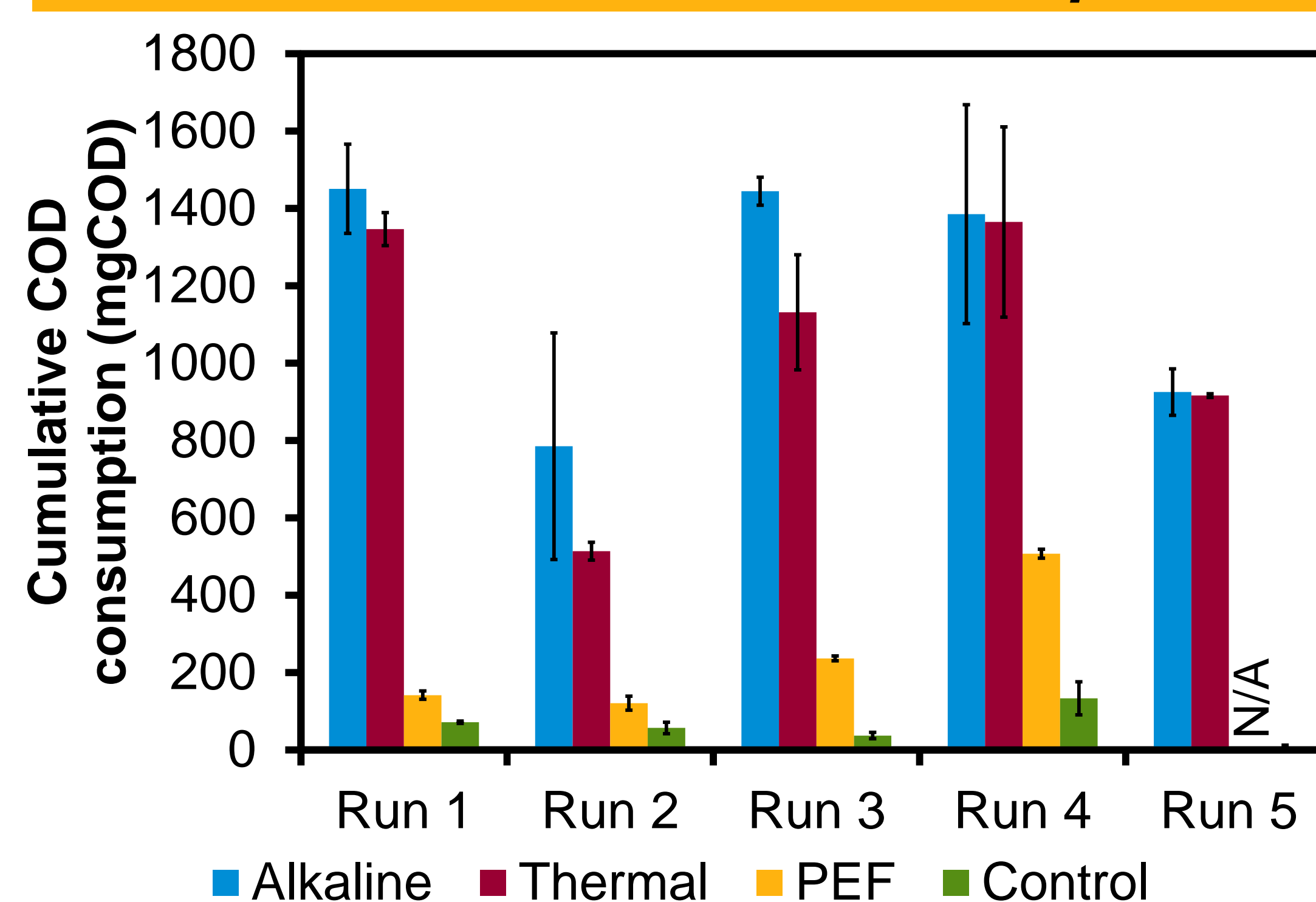
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Alkaline and thermal pretreatments release additional SCOD in the form of VFAs
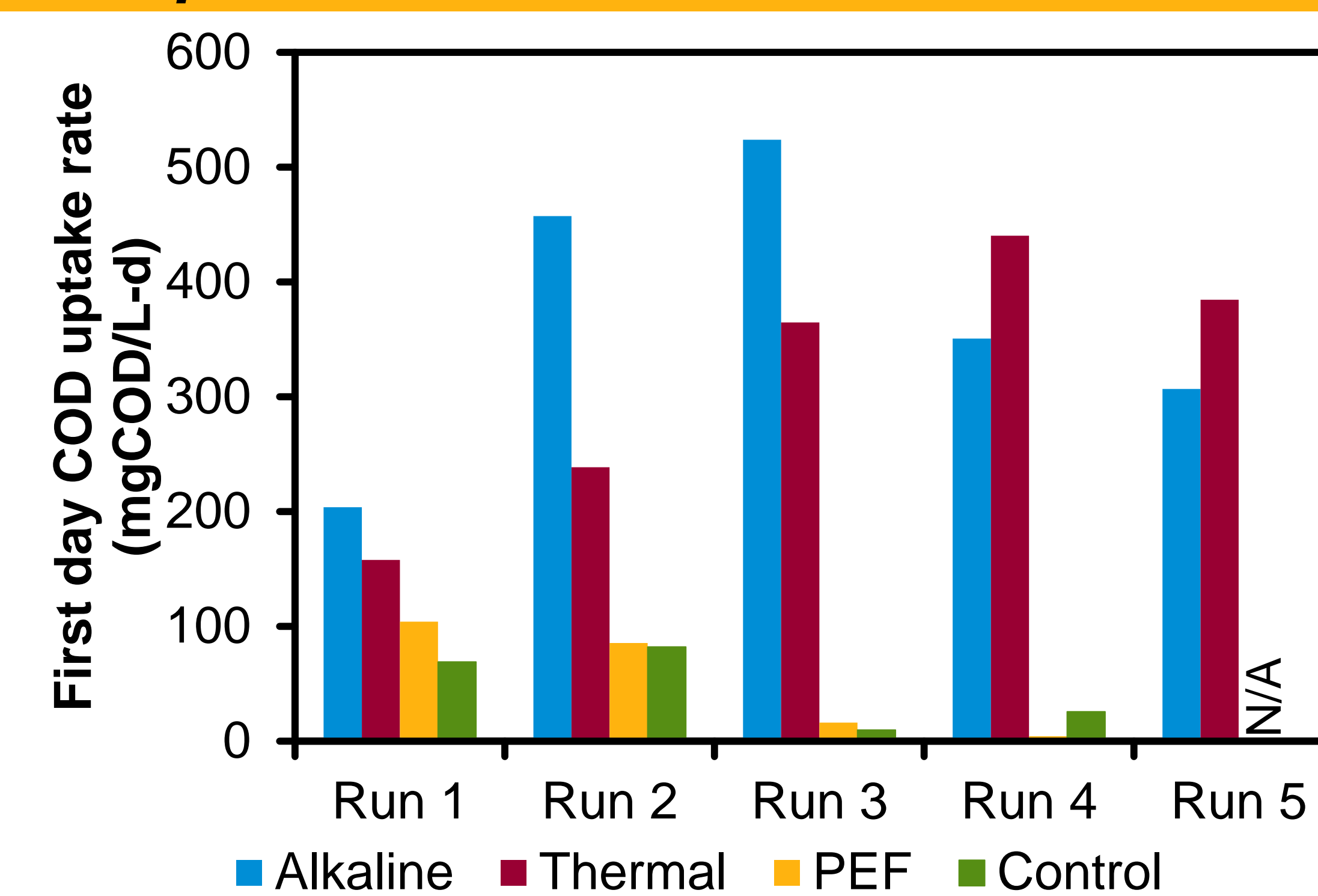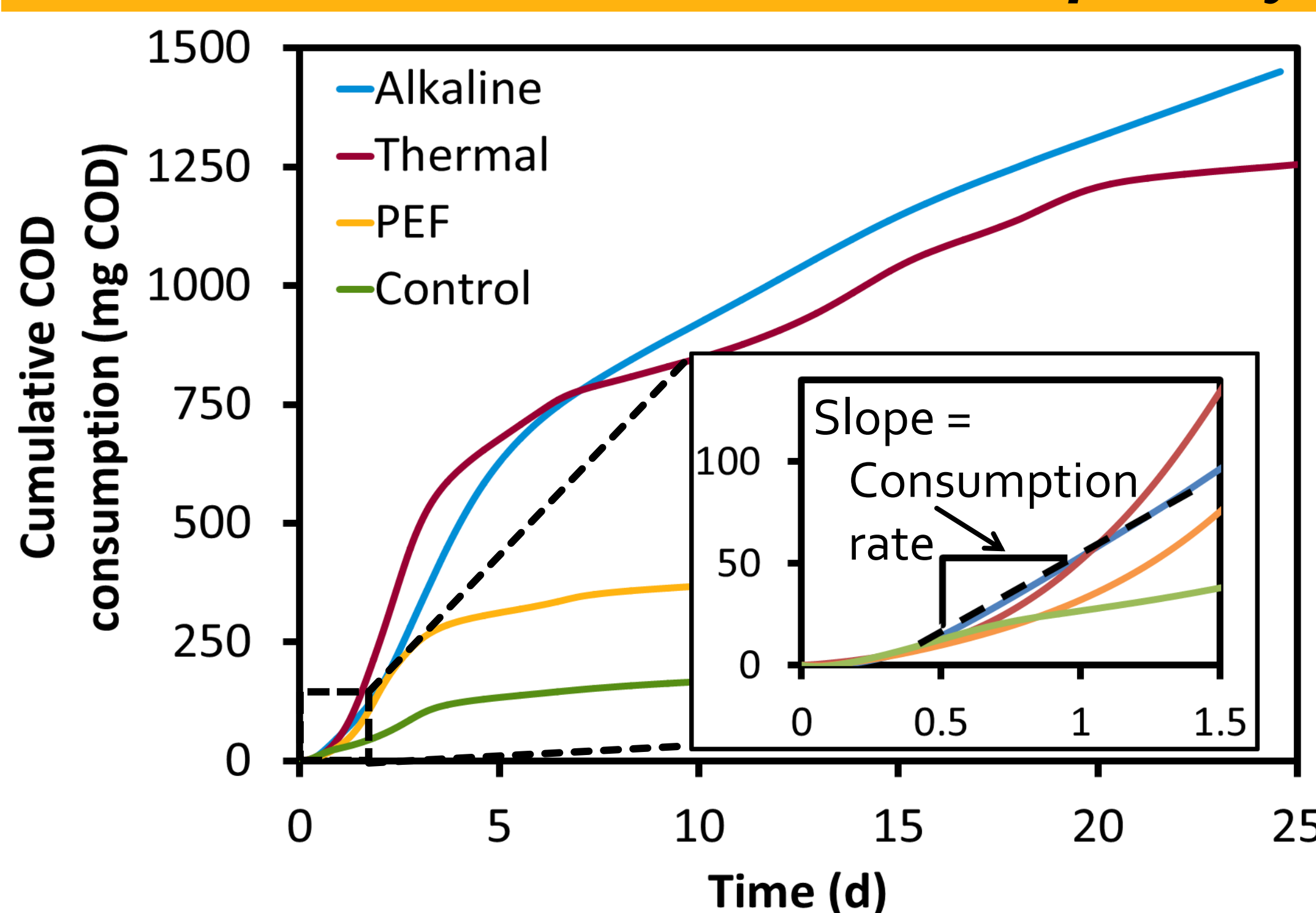

VFAs were not detected in control or PEF samples.

MECs' COD consumption echoes initial COD concentrations

All runs exhibit the same trends for percent COD recovery based on current and percent removal based on initial and final COD values. No VFAs were detected at the end of runs.
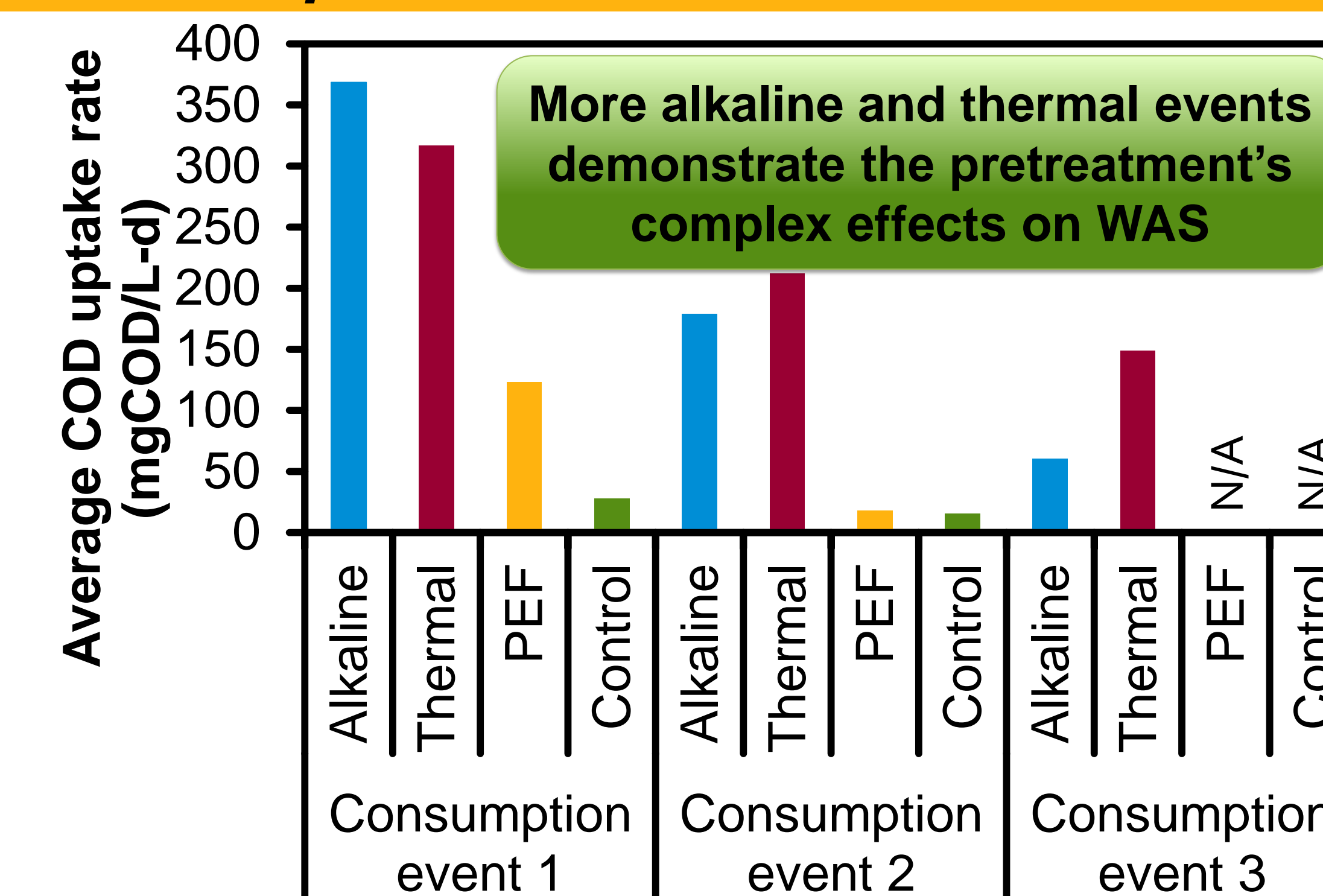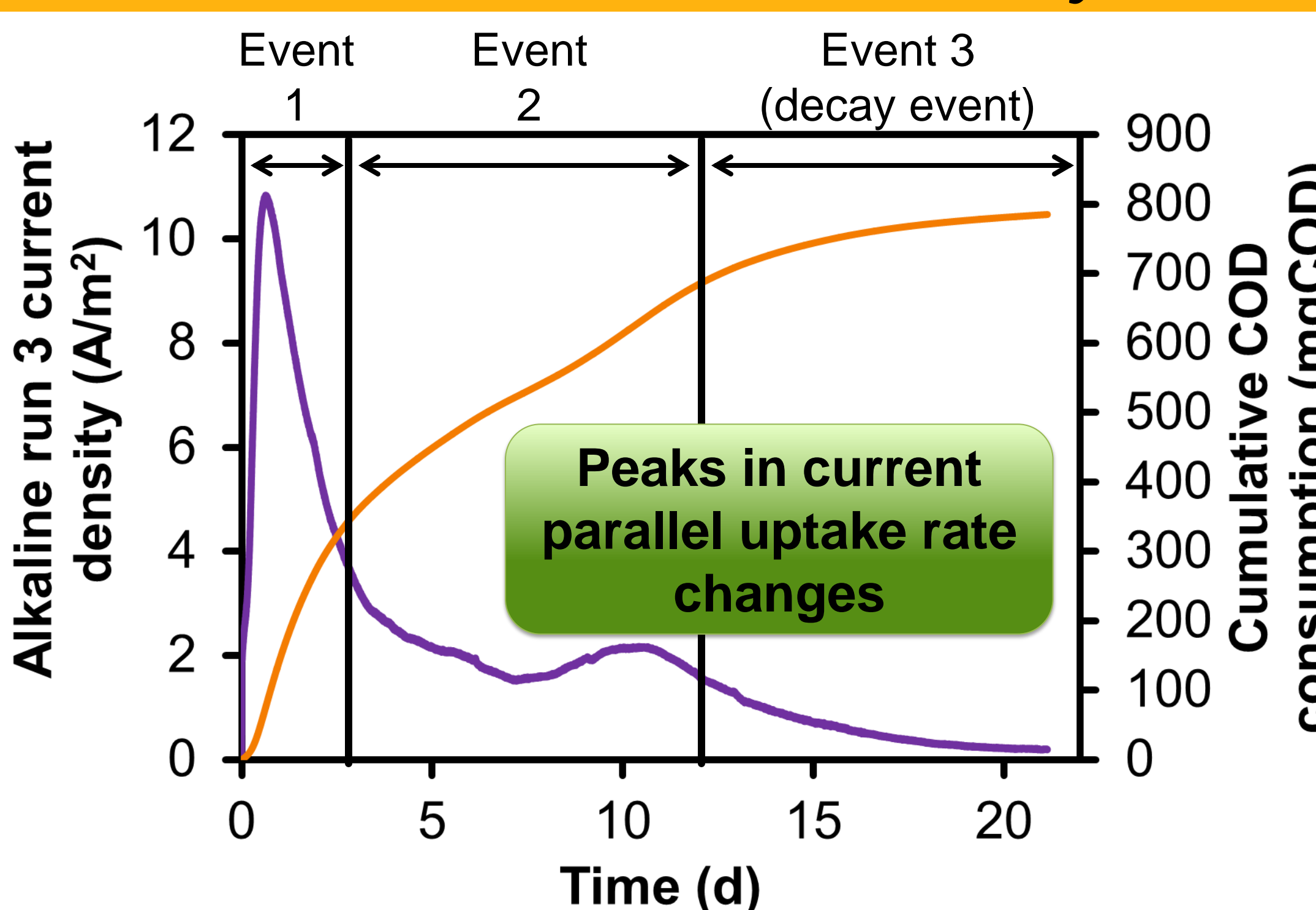
MECs quantify COD uptake rates

Slope = Consumption rate

COD uptake rates can be obtained from the slope of COD consumption.

Uptake rates are heavily influenced by initial VFA concentrations, particularly acetate.

MECs identify different consumption events

Event 1, Event 2, Event 3 (decay event)

Peaks in current parallel uptake rate changes

More alkaline and thermal events demonstrate the pretreatment's complex effects on WAS