

# Eco-friendly Recovery of Nitrogen Oxides: Recycling HNO<sub>3</sub> from Glucose-Nitric Acid Reactions

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## ABSTRACT

A recycling process was performed in which NO<sub>x</sub> gas, generated from the reaction of glucose with nitric acid, is converted into nitric acid by reacting with water. Nitrogen compounds generated from the reaction of glucose and nitric acid cause pollution to the environment; therefore, it is necessary to utilize them as sustainable resources. NO<sub>x</sub> gas exists in the form of NO and NO<sub>2</sub>, and NO gas is converted into NO<sub>2</sub> by utilizing its property of being oxidized in the atmosphere. In this study, nitric acid was produced by first generating NO<sub>x</sub> gas using 70% nitric acid, then reacting this gas with water at temperatures of 25, 40, 60, and 80 °C. The flow rate of NO<sub>x</sub> gas was confirmed using a gas analyzer. The oxidation reduction potential(ORP) and pH of recycled nitric acid of various concentrations were measured using a pH meter. As a result, nitric acid was successfully synthesized through an environmentally friendly reaction and is expected to be used as a sustainable resource.

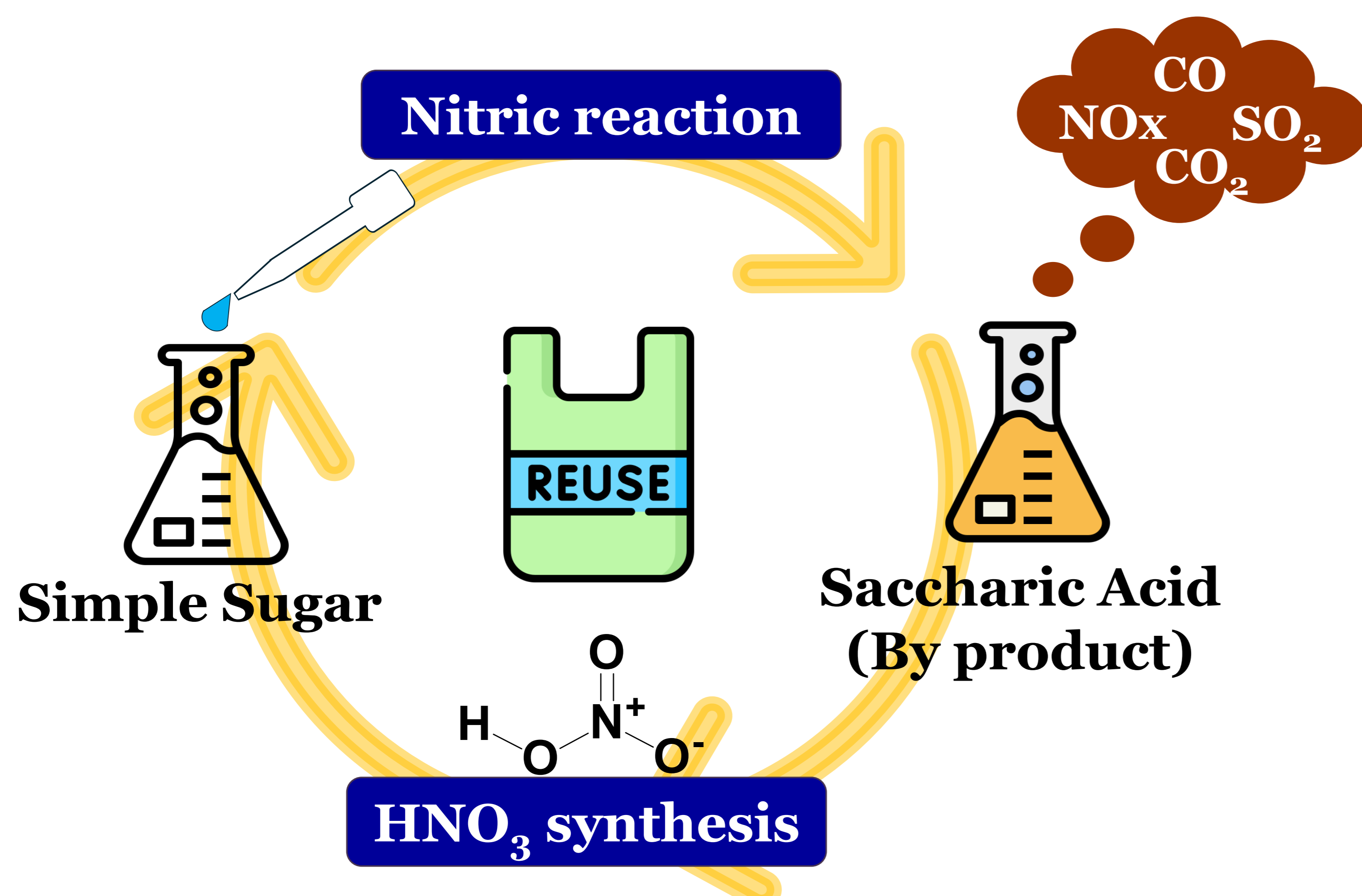
## OBJECTIVE

To investigate the generation of NO<sub>x</sub> gases from the reaction between monosaccharides and nitric acid, and to explore their subsequent conversion into concentrated nitric acid.

To establish optimal conditions for the nitrification and concentration of NO<sub>x</sub> gases generated through monosaccharide-nitric acid reactions, aiming at the regeneration of high-purity nitric acid.

To develop a sustainable process for recovering and concentrating nitric acid via NO<sub>x</sub> gas capture and conversion, using monosaccharide-based reactions as a precursor route.

## EXPERIMENTAL



Step 1 Reaction of Monosaccharides with Nitric Acid

Step 2 Conversion of pollutant gases into nitric acid through synthetic processes

Step 3 The recycled nitric acid is reused under the same reaction conditions to ensure consistency

Figure 1. Experimental scheme illustrating the closed-loop use of HNO<sub>3</sub> through a recycling and reuse process.

## CONCLUSIONS

- ✓ This study identified the formation conditions of NO<sub>x</sub> gases resulting from the reaction between monosaccharides and nitric acid.
- ✓ Specific conditions for NO<sub>x</sub> gas collection zones were established, and experiments confirmed the regeneration of nitric acid via reaction with water.

## ACKNOWLEDGEMENT

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## RESULTS

### Reaction condition

	Dilution w/DI water (%)	Nitric acid (%)	Temperature (°C)	rpm	Titration (n/sec.)	Reaction Time	
#1	1:1 = 50	69	25	200	2 drop wise / sec	2h	NOx gas X
			25		1 drop wise / sec	40m	NOx gas X
#2	1:1 = 50	69	40	200	2 drop wise / sec	2h	NOx gas X
			40		1 drop wise / sec	40m	NOx gas X
#3	3:1 = 75	69	40	200	1 drop wise / sec	40m	NOx gas X
			60		1 drop wise / sec	1h30m	NOx gas O

### Fourier-transform infrared spectroscopy

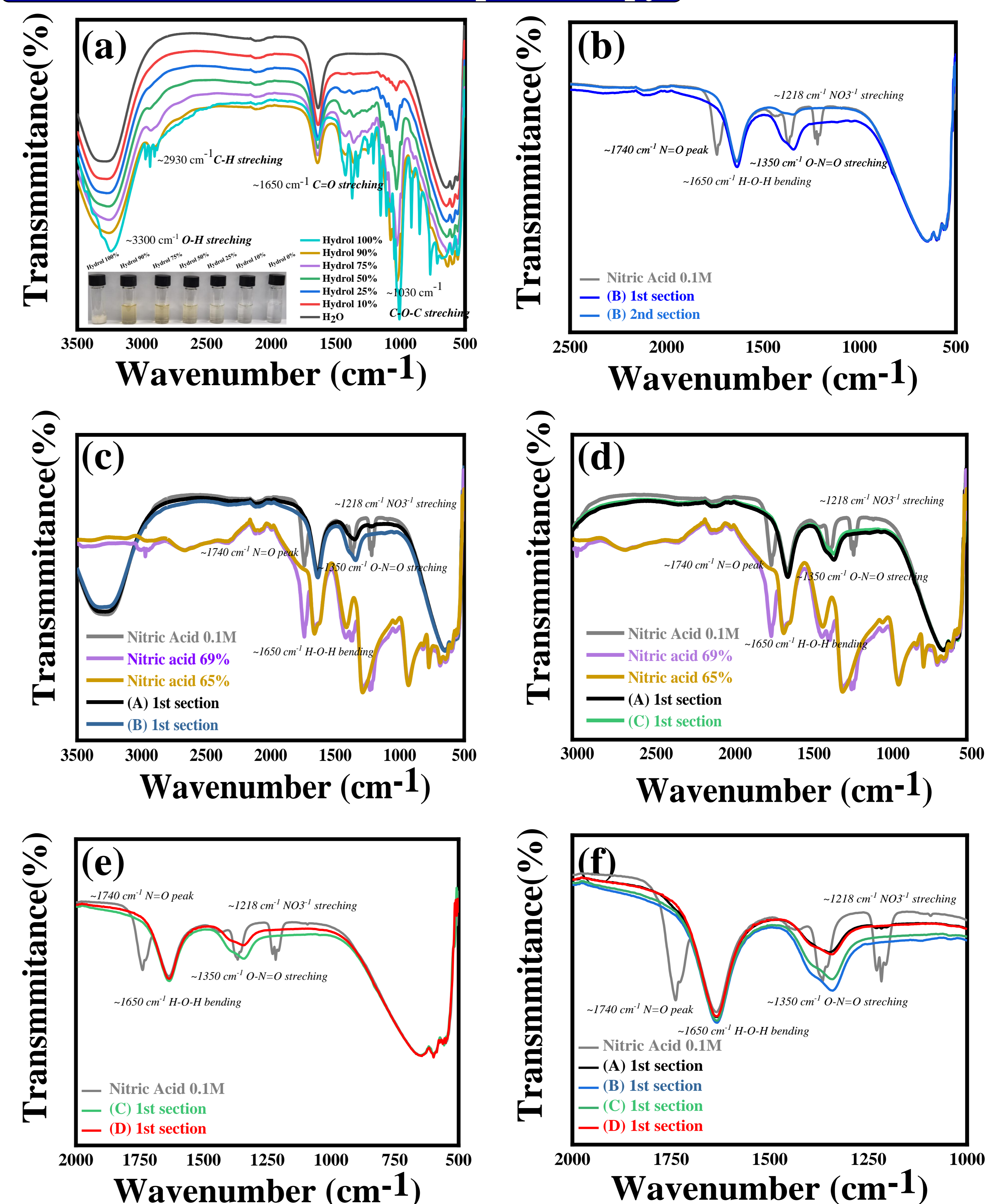
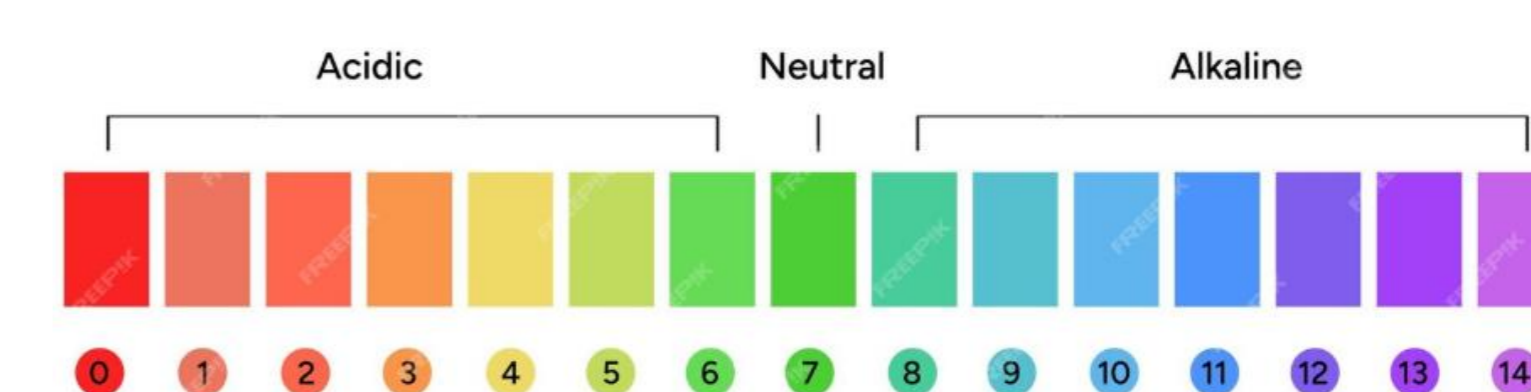


Figure 2. FT-IR analysis results are presented based on: (a) raw material dilution; (b) collection zone; (c) oxygen injection conditions; (d) temperature variation in the collection zone; (e) use of highly concentrated raw materials; and (f) comprehensive integration of remaining variables.

### pH meter



	Samplig Zone	Test A	Test B	Test C	Test D	0.1M HNO <sub>3</sub>	65% HNO <sub>3</sub>	69% HNO <sub>3</sub>
pH	1st	0.34	-0.03	0.06	0.26	1.04	-1.94	-2 ↑
	2nd	0.30	0.74	0.62	0.94			

Figure 3. Results of pH concentration analysis of nitric acid formed through the reaction of generated nitrogen oxide gases with water