For each problem, show the details of your calculations (equations, units etc.).

Problem 1

1500 lbs/hr of a waste mixture of 40% benzene, 50% toluene, and 10% water is burned with 25% excess air. Determine the total heat release and the % by volume of carbon dioxide in the flue gas.

Problem 2

An incinerator that normally burns waste with a heating value of 700 to 1000 Btu/lb and is designed to handle $2*10^7$ Btu/hr must burn a rubber waste with a heating value of 12,000 Btu/lb. Estimate the maximum size of a waste batch for this system to perform effectively. Assume the residence time in the incinerator is 6 min.

Problem 3

An incinerator that operates 5 days a week and 24 hours per day year round emits flue gas containing 670 lbs/hr sulfur dioxide and 450 lbs/hr hydrochloric gas. The flue gas is treated with sodium hydroxide to remove both of these emissions prior to discharge to the atmosphere. What is the amount of sodium hydroxide needed if the emission limits for sulfur dioxide and hydrochloric gas are 25 tons/year and 4 lbs/hr, respectively?

Problem 4

The hazardous waste mixture shown in the table below is incinerated at 2200°F with 50% excess air, a residence time of 2.3 s, and a stack flow rate of 37,500 dscfm. The principal organic hazardous constituents for this waste are benzene, tetrachlorophenol, and toluene. The table below shows the incinerator emissions. Determine if this emission meets requirements for organic contaminant, particulate, and hydrochloric gas removal?

Compound	Formula	MW	Inlet, lbs/hr	Outlet, lbs/hr
Benzene	C_6H_6	78.11	1025	0.087
Chlorobenzene	C_6H_5Cl	112.5	278	0.034
Ethylbenzene	C_8H_{10}	106.17	780	0.089
Tetrachlorophenol	C_6HOHCl_4	231.9	760	0.056
Toluene	C_7H_8	92.1	756	0.024
Xylene	C_8H_{10}	106.17	168	0.204
HCl		36.45		4.3
Particulates				20.3