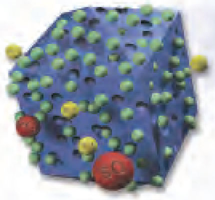


BICARB BULLETIN

Deacidification of Medical Waste Incinerator Gases with Sodium Bicarbonate

HCl Removal with Sodium Bicarbonate Injection at Colorado Incineration Services, Inc., Denver, CO

The efficacy of sodium bicarbonate in reducing SO_2 and other acid pollutants from stack gases is well-known.

This report highlights a process that optimally reduces hydrogen chloride (HCl) emissions and other pollutants below that characteristically observed from medical waste incinerators (MWIs) with dry sorbent injection/fabric filter air pollution control device (APCD) technology. Using ARM & HAMMER® Sorbent Grade Sodium Bicarbonate, HCl removal at the Colorado Incineration Services, Inc. (CISI) facility, near Denver, Colorado, was **99.3** percent.

Case Background

CISI was incorporated in 1989 to handle and dispose of infectious waste according to the guidelines set by Colorado's New Source Performance Standard (NSPS) for MWI emissions. In June 1994, CISI ceased incineration operations. However, the data remains both valid and valuable from which similar operations can benefit.

CISI provided medical waste incineration services to hospitals, doctors' offices and clinics throughout Colorado, Wyoming, Nebraska and New Mexico. Additional materials were handled from pharmaceutical manufacturers and laboratories, industrial clinics and dental offices.

Church & Dwight Co., Inc.
469 North Harrison Street • Princeton, New Jersey 08543-5297
Technical Service: 1-877-4BICARB (1-877-424-2272) • Sales: 1-800-221-0453
www.ahperformance.com

System Description

For its size (750-pounds-per-hour) CISI used a slightly different process than most conventional MWIs by operating in a continuous cycle rather than in batches. The facility operated continuously, going to stand-by mode when the APCD was pulsed down and the fabric filter was pre-coated. After baghouse pulsing and precoating, gas flow was re-established to the APCD.

The facility used a dual chamber, starved-air incinerator (Reference CISI plant flow diagram). The solid waste feeder supplied waste to a stationary hearth gasifier (primary chamber) which operated at 1600°F and used a 29-foot rotary ash kiln to gasify 95 percent of the solid waste.

Volatile organic compounds (VOCs) produced during this process were dissipated in a thermal oxidation chamber. This secondary chamber operated between 2150°F-2300°F with 100 percent excess air. Flue gases from this chamber entered five cross flow, air-to-air tubed heat exchangers (two ceramic and three stainless steel) and cooled to 375°F. Pollutant-laden gases then entered the APCD for pollution reduction.

There were five categories of pollutants generated by the medical waste. First was metals, which included arsenic, beryllium, cadmium, chromium, lead, mercury and nickel. The second type was chlorine isomers. The last three categories were HCl, carbon monoxide and particulate matter.

APCD Operating Mode

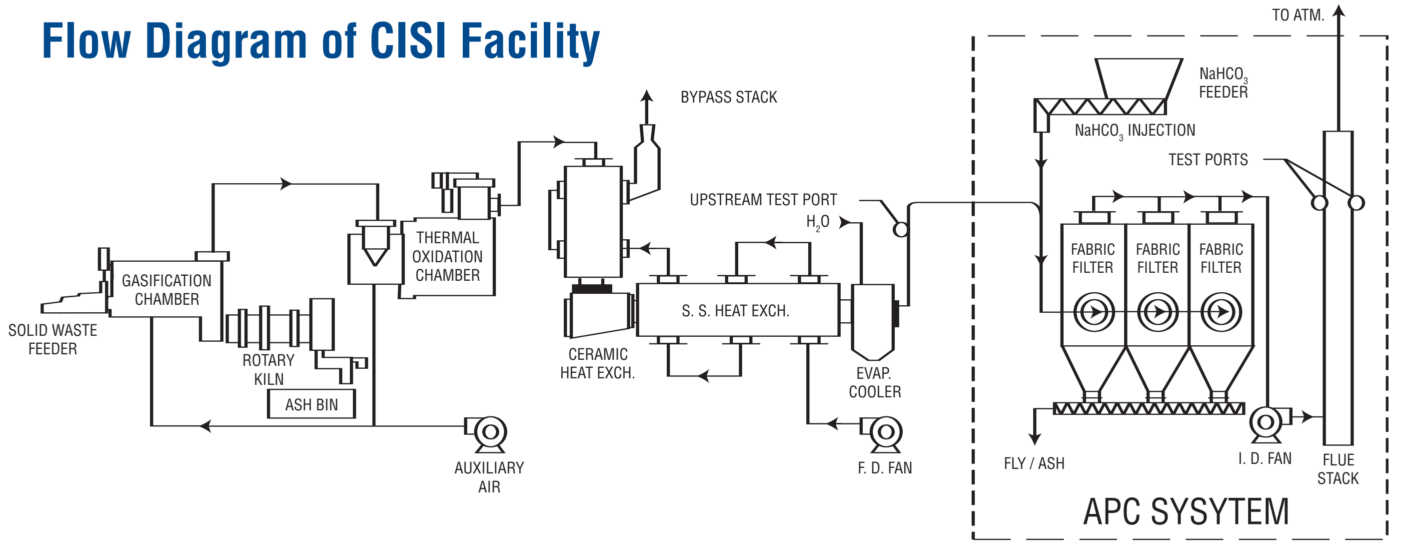
Pollutant-laden gases entered the APCD, which consisted of a sodium bicarbonate-injected fabric filter system that used 168 bags divided among three chambers, for a total filtration surface area of 1385 square feet.

To reduce pollutant emissions below that considered acceptable by most regulators and APCD manufacturers, CISI applied and maintained a sodium bicarbonate ($NaHCO_3$) precoat injection onto the fabric filter bags during the entire burn cycle.

ARM & HAMMER® Sorbent Grade Sodium Bicarbonate was metered and pneumatically injected into the waste gas stream at 350°F to 375°F, and thermally decomposed for maximum scrubbing. The injection of dry sorbent at a rate of 38.5 pounds per hour fully neutralized the HCl, based on a maximum waste output of 10 pounds per hour.

The baghouse operated on an automatic differential pressure (ΔP) cleaning cycle which activated when pressure drop across each filtration chamber rose above eight inches of H_2O. Operators could control the cleaning cycle by manually overriding the automatic system. This cleaning cycle began with a one-hour burn down, during which the waste feed was terminated, which lowered pollutant emissions across the APCD.

Flow Diagram of CISI Facility



Deacidification of Medical Waste Incinerator Gases with Sodium Bicarbonate

All chambers were fully pulsed to remove fly ash and residue. A precoat layer of sodium bicarbonate was then injected into the baghouse to re-establish a filter cake of approximately 1/64 of an inch on the fabric filter surface (CISI's system requires a total of 200 pounds $NaHCO_3$ to achieve this precoat). Such precoating resulted in a pressure drop of less than 0.4 inches of H_2O across the APCD. The baghouse was then put on-line and sodium bicarbonate injection resumed to a 38.5 pounds per hour level as waste feed was re-established. The system typically operated for 12 hours of continuous service before a differential pressure-based cleaning cycle (described above) was required.

Sorbent Stoichiometry / Reaction Mechanism

Upon injection into the hot flue gas stream, sodium bicarbonate undergoes rapid thermal decomposition. This results in a highly porous, high surface area particle which has significant affinity to neutralize acidic emissions such as HCl. Acid/base neutralization of HCl is represented in the following stoichiometric reaction:

$$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$$

Water vapor and carbon dioxide produced by this reaction vent to the atmosphere through the flue. The neutral salt reaction product (sodium chloride), along with the fly ash and unreacted sorbent, collect as filter cake on the fabric filters in the baghouse.

Results

Through injection of sodium bicarbonate, HCl emissions were reduced by an average of 99.3 percent based on Colorado State certified stack test results (Reference Table 1).

In addition, other pollutants such as particulate, metals and dioxins were well within state regulatory requirements (Reference Table 2).

Compared to other sorbents, sodium bicarbonate results in high utilization efficiencies, improved baghouse performance due to reduced pressure drop, and improved operational and mechanical reliability due to its non-corrosive, non-erosive nature. At the same time, the reduced spent sorbent volume decreased disposal costs and minimized the negative environmental impact.

Other notable advantages observed by CISI included the assurance of worker safety, easy-to-handle neutral salt by-products and improved particulate control device performance.

By using ARM & HAMMER® Sorbent Grade Sodium Bicarbonate, data collected demonstrate that a dry scrubber APCD can operate extremely efficiently with minimal system modifications.

Table 1: CISI stack test results (EPA method 26)

Stack Data	Run Number				
	1	2	3	4	Avg.
Volumetric Flow (ACFM)	7569	8062	6716	7936	7571
Volumetric Flow (DSCFM)	3988	4107	3458	4141	3924
Temperature (°F)	345	354	354	356	352
Moisture (Vol.%)	4.3	6.4	5.5	4.0	5.1
Hydrogen Chloride (@ 7% O_2)					
Scrubber Inlet (ppm)	807	1022	1152	905	1009
*Stack (ppm)	6.6	7.7	8.3	5.4	7.1
HCl Removal Efficiency	99.2	99.2	99.3	99.4	99.3

*Department of Environmental Conservation

Table 2: CISI stack test results

	Test Number		
	1	2	3
Facility Data			
Primary Temp (°F)	1700	1700	1700
Secondary Temp	2250	2250	2250
APCD Type	FF	SI	FF/SI
Waste Type	General/Red	General/Red	General/Red
Sorbent	$NaHCO_3$	$NaHCO_3$	$NaHCO_3$
Stack Conditions			
Flow Rate (ACFM)	7,729	8,018	7,977
Temperature (°F)	358	376	350
Moisture (Vol.%)	5.8	4.9	6.5
Metals µg/dscm @ 7% O_2			
Arsenic	1.17E – 0 1	6.68E – 0 2	-1.78E – 0 2
Cadmium	1.26E + 0 0	1.57E + 0 0	7.99E – 0 1
Chromium	2.23E + 0 0	8.18E – 0 1	1.38E + 0 0
Lead	2.35E + 0 1	1.50E + 0 1	1.24E + 0 1
Mercury	2.26E + 0 3	2.14E + 0 3	1.28E + 0 3
Dioxin ng/dscm @ 7% O_2			
2,3,7,8 TCDD	8.70E – 0 1	4.70E – 0 1	2.30E + 0 0
2,3,7,8 TCDF	4.45E + 0 0	5.20E – 0 1	3.40E – 0 1
Total PCDD/PCDF	5.32E + 0 0	9.90E – 0 1	2.64E + 0 0
Particulate gr/dsccf @ 7% O_2			
PM	6.08E – 0 3	4.51E – 0 3	5.21E – 0 3

FF = Fabric Filter, SI = Sorbent Injection, $NaHCO_3$ = Sodium Bicarbonate