Niacet

Critical Materials Council Presentation

Peter Buckley

24th April 2018

World - Class Quality

World - Class Reputation

Niacet - Niagara Falls, NY, USA

Historical Background

- Plant Operations began in 1924
- Joint ownership of E.I. DuPont, Shawinigan Power, and Carbide and Carbon Chemicals

- First semi-commercial plant based on acetylene (**Ni**agara **Acet**ylene) Niacet Chemical Company

- One of the first plants to produce:
  - synthetic glacial acetic acid from acetaldehyde
  - synthetic methanol
  - polyvinyl butyrate for safety glass

- Acetate derivatives followed

Niacet - Niagara Falls, NY, USA

Historical Background (cont'd)

- 1946 - Purchased by Union Carbide
- Anionic Surfactants, carboxymethyl cellulose,"Crag" herbicide, propionates
- 400 employees
- 1970's – Reduced to two product lines, $5 million annual sales, 38 employees
- 1978 – Plant is sold and Niacet Corporation is formed
- 2005-2011 completed $20 million investment in expansion of most production lines
- February 1st, 2017: partially acquired by SK Capital Partners

…only a few miles from the famous Niagara Falls …

Niacet – Tiel, The Netherlands

Historical Background

- Established in 1910's: producing glass flasks and agro-chemicals
- 1941: name "Verdugt" introduced
- 1960: start of Propionates/Acetates production
- 1981: acquired by BP (as forward integration of organic acids)
- 1999: acquired by US Salt Holdings LLC
- 2000: acquired DCV (US propionates producer)
- 2001: acquired Droiban Spain (acetates producer)
- 2004: acquired by CVC Capital Partners
- 2005: acquired by Kemira and formation of Kemira ChemSolutions
- 2013: acquired by Niacet Corp.

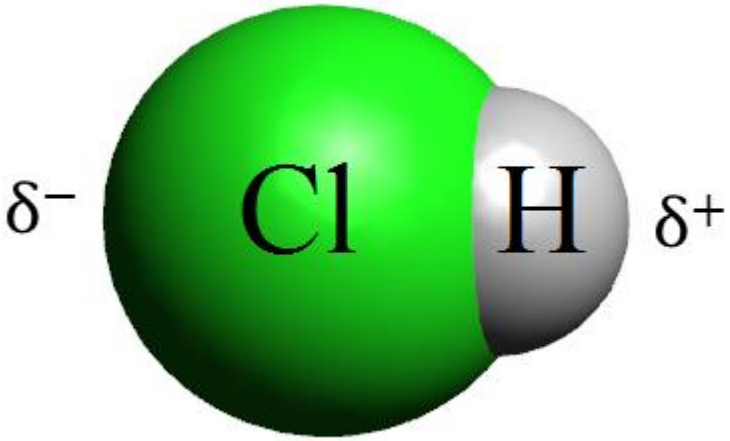
… Situated in the fruit producing heart of the Netherlands…

Niacet in 2018……

- Has two production sites (USA & the Netherlands)
- Has one Global Executive Management
- Has a core focus on acetates and propionates
- Is a global market leader
- Has an exclusive portfolio of >30 different products
- Employs >200 people
- Values job and financial security for employees

Niacet Probake CP Granular

Anhydrous Hydrogen Chloride



Applications of Anhydrous Hydrogen Chloride

- Anhydrous Hydrogen Chloride is sold as a liquefied gas in cylinders or tube trailers.
- AHCl is used in the semiconductor industry in two main applications:
  - The manufacture of Semiconductor and Solar grade Silicon
  - In situ pre-cleaning prior to epitaxial deposition during semiconductor manufacturing.
- AHCl is highly reactive with drug bases to form solid hydrochlorides which can then be tableted.
- Around 3,000 APIs in the US FDA drug master file are classified as hydrochlorides.
- Myriad of Technical applications- cotton delinting, metal treatment , leather tanning, Manufacture of fertilizers, dyes, dyestuffs, artificial silk, and pigments for paints, pickling of metals including stainless steel, iron, nickel, and Monel .Oxyhydrochlorination processing in production of chlorinated hydrocarbons

Properties of Anhydrous Hydrogen Chloride

- Signal word- Danger

- **Hazard statements**
  - Cylinder contains liquefied gas under pressure, may explode if heated.
  - Toxic if inhaled
  - Causes severe skin burns and eye damage.
  - Causes serious eye damage.
  - May cause respiratory irritation.

AHCl reacts with the moisture in the air forming fumes, which are a mist of hydrochloric acid. Aqueous hydrochloric acid is a highly corrosive liquid.

Manufacture of AHCl

- Most AHCl manufactured is from byproduct streams
  - Vinyl Chloride for PVC - Oxychlorination process :Ethylene & Chlorine to form EDC liberates AHCl with reacts with Ethylene. EDC is dehydrated and thermally cracked to form VCM. Originally process used acetylene still used in China.

  - Allyl Chloride is produced in chlorination of propylene , Allyl chloride is used to manufacture Epichlorohydrin used in production of plastics :

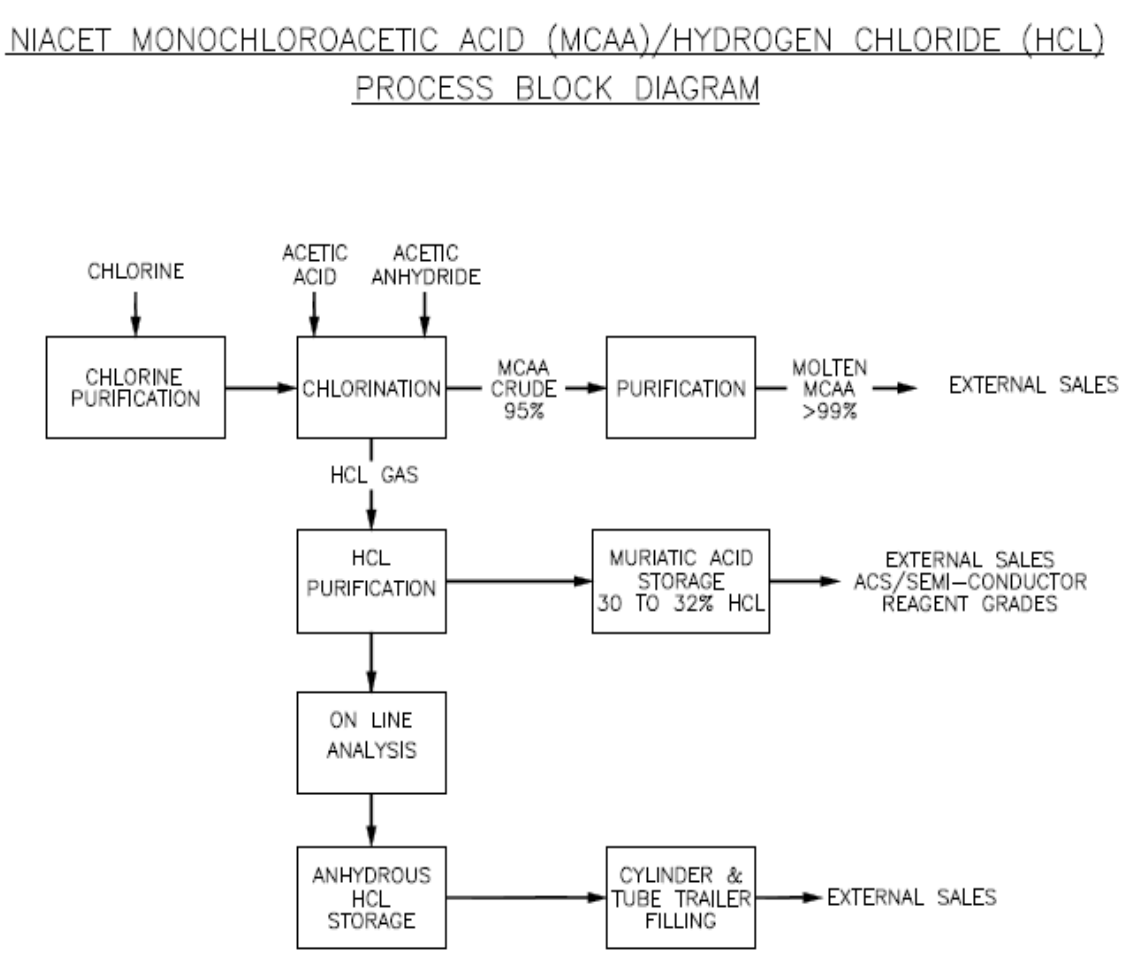
$$CH_3CH{=}CH_2 + Cl_2 \rightarrow ClCH_2CH{=}CH_2 + \underline{HCl}$$

The issue with these processes is it is very difficult to remove chloro-carbons from the AHCl. The chloro-carbons can have adverse effect on semiconductor processing.

Niacet Manufacture of AHCl

- Niacet produces monochloroacetic acid. Hydrogen chloride is a by-product of the chlorination reaction of acetic acid and is separated and purified.
- Niacet is the only domestic manufacturer of MCAA to the free US market.
- Niaproof® MCAA is used in the production of carboxymethylcellulose(CMC), which is then used in a variety of applications:
  - Drilling solution for oil wells
  - Thickening agents
  - Personal care preparations
- MCAA is also a raw material for chemical synthesis in the manufacture of:
  - Pharmaceutical preparations (caffeine, vitamins, barbiturates, Antibiotics, dextrin)
  - Cosmetic applications (hair permanent waving formulations, hair depilatory formulations)
  - Herbicide production (2,4-dichlorophenoxyacetate)
  - Dyestuffs (indigo), PVC stabilizers
- No Chlorocarbons are produced in the process- very clean product

Process Flow Diagram

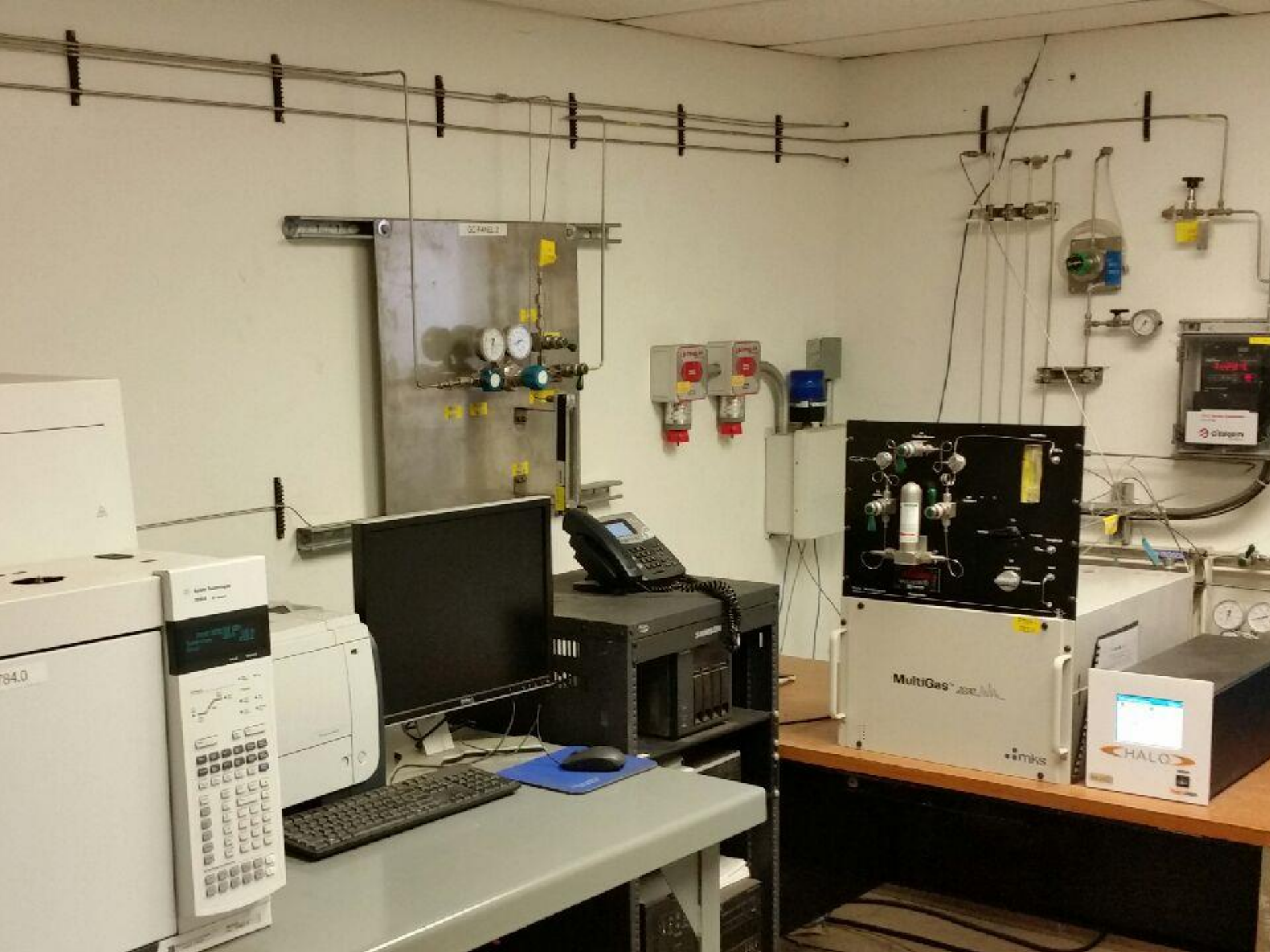


Niacet History of manufacturing AHCl

- A distillation module was designed and built in 1991 and produces high purity (up to 99.999%) hydrogen chloride.
- Electronics grade 10M muriatic acid was initially produced and sold from the unit after start-up in 1992.
- The muriatic acid produced was then sold as food grade 10M product and is diluted with potable city water.
- Since June 2013 Niacet has been producing and selling pharmaceutical and technical grade anhydrous HCl loaded in 21,000 pound tube trailers through Alexander Chemical.
- In November 2017 Niacet purchased the assets and customer list from Alexander Chemicals.
- In Jan 2018 Distillation column was successfully commissioned. CO2 levels below 1 ppm cf 300ppm previously.
- August 2018 Niacet building a cylinder filling facility at Niagara Falls.

Niacet Analytical Capability

	Detection Limit	
Contaminant	ppmv	Method
Carbon Dioxide	0.02	GC-PDHID
Carbon Dioxide	0.5	FTIR
Water	0.002	CW-CRDS
Methane	0.04	GC-PDHID
Carbon Monoxide	0.4	GC-PDHID
Nitrogen	0.07	GC-PDHID
Oxygen/Argon	0.1	GC-PDHID
Metals	ppb	ICP-MS


MultiGas
mks
HALO

AHCl -3rd Party analysis results

- “No hydrocarbons were detected. The GC/FID is also capable of detecting higher molecular weight hydrocarbons. No additional impurities were detected on the GC/FID”.
- “Niacet material had notable absence of most C1-C3 hydrocarbons with the Niacet material being very clean for hydrocarbons in the sub-ppm levels.From this analysis, Niacet HCl showed less hydrocarbon impurities than the incumbent HCl supply.”
- “No chlorocarbons were detected in the Niacet samples.”

2018 April samples analyzed

CERTIFICATE OF ANALYSIS 1

Description
NIACET ANHYDROUS HCl 5N 60LB CYL

Code	**Gross Weight**	**Net Weight**
52806	0.000	0.000
Batch	**Manufacturing date**	**Expiration date**
30000XXXXX	03/27/2018	03/27/2020

Characteristic	Result	Specificatio	Unit
Moisture	0.86	<= 1.0	ppm
Hydrogen Chloride,wt%	99.999	>= 99.999	%
Carbon Dioxide,ppm	< 1.0	<= 4.0	ppm
Carbon Monoxide,ppm	< 0.4	<= 1.0	ppm
Argon / Oxygen,ppm	< 0.1	<= 1.0	ppm
Nitrogen,ppm	2.7	<= 3.0	ppm
THC (as Methane),ppm	< .04	<= 1.0	ppm
Remarks:			

This Certificate of Analysis is based on batch specific analysis. Parameters marked with * are not tested for every batch, but these are tested periodically. All our raw materials are obtained from only approved suppliers and match with our raw material specifications according to our ISO 9001 quality management system. Representative samples of each batch are retained for three years and the analysis results of each batch are archived for 10 years. Each sales order is directly linked to (a) batch number(s).

This CoA is only valid when the product is in its original undamaged packaging and when stored under the recommended conditions.

This Certificate of Analysis has been approved electronically and is valid without a signature.

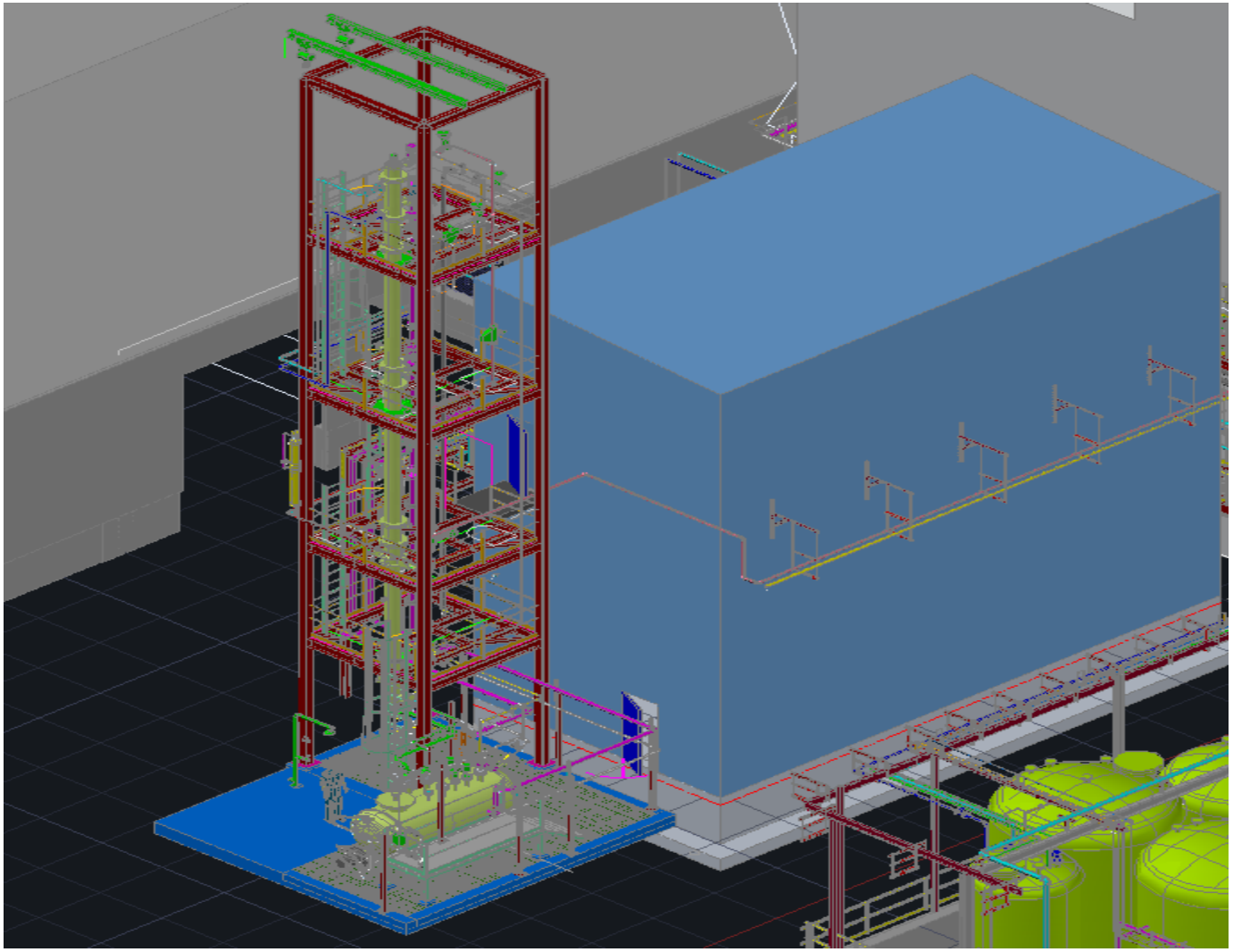
Approved by:
Manager, Quality Assurance
Niacet Corporation
Salvatore J. D'Angelo

Niacet Corporation
400 47th Street
Niagara Falls, NY 14304

Phone +1 716 285 1474
Fax +1 716 285 1497

www.niacet.com
niacetcsr@niacet.com

Chlorine Distillation Module – 3D model



Chlorine Distillation Column

Chlorine Reboiler

Foundation Piers and Column supports

Finished Foundation for Column Structure

Column Structural Steel Erection – Jun17

Completed and Commissioned- Jan 2018

Niacet Grades of AHCl

Tech Grade N 3.5 99.95%

CO_2 - <10ppm ; N_2+O_2 - <85 ppm ; H_2O- < 5ppm

High Purity/Electronic Grade N4.7 99.997%

CO_2 - <5ppm ;N_2+O_2- <14 ppm ; H_2O - < 2ppm

ULSI Grade N 5.0 99.999%

CO_2 - <4ppm ; N_2+02 - 4ppm ; H_2O< 1ppm

Niacet Strategic Position on AHCl

- Niacet wants to be a reliable high purity supplier to the pharmaceutical and semiconductor industry.
- Key driver is return on investment, consider export markets, not afraid to go directly to the market.
- Future expansion linked to MCAA volumes.
- Continue discussions with major gas companies and other potential partners

Next Steps for Niacet

- Need to build robust SQC data package for semiconductor and pharmaceutical industry.
- Construct and commission the filling facility in August use results to generate SQC data.
- Run column permanently in mode to generate data in N5.0+ range.
- Continue detailed conversations with customers - LISTEN

Thank you!

Check our website for more information:
www.niacet.com