FAST FACTS

ETHYLENE OXIDE

The Extrel® MAX300™ series of process mass spectrometers exceeds EO Licensor's requirements for real time, online process analysis and control.

Extrel has over 30 years of successful process mass spectrometry experience and is widely known for providing the best customer and technical support in the industry. Extrel customer benefits include:

- Typical analysis time is less than 10 seconds per stream.
- Ability to measure components in the feed, recycle, CO^2 absorber overhead and multiple reactor effluents in about one minute.
- Report the 9 major components plus chloride inhibitors in both nitrogen and methane ballast processes.
- Accurate analysis allows for precise control of carbon and oxygen balances to within +/- 2%, optimizing product yield.
- The Extrel MAX300 supports a variety of industry standard communications including ethernet, Bi-directional MODBUS, MODBUS RTU or TCP/IP, OPC and analog communication protocols.

Extrel process mass spectrometers are a proven success in the industry with dozens of worldwide installations over the last 30 years. Extrel mass spectrometers are approved and/or used by the two largest licensors of EO technology.

Typical Analysis Information

The Extrel MAX300 will measure the components in the reactor inlet stream (feed plus recycle) and multiple reactor outlet streams. Typical stream compositions for a methane ballast are shown in Table 1.

Accuracy and stability of these measurements are critical as the information is used to calculate control parameters such as carbon and oxygen balances and selectivities. Figure 1 contains data from a twenty-day production run measuring the EDC at the Outlet (top trace) and the Inlet (bottom trace) of the reactor.

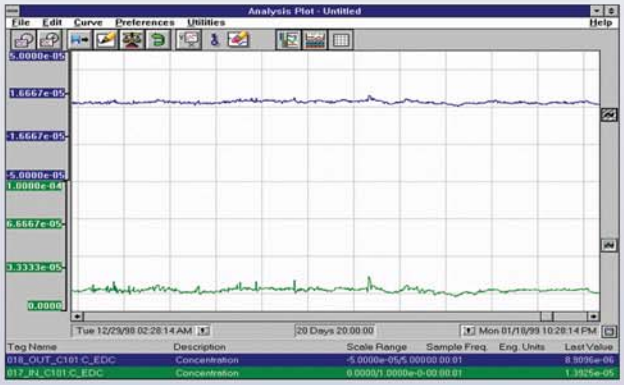

Figure 1. 20-Day Trace of EDC at the Reactor Outlet and Inlet

Note the precision. The concentration of EDC in the reactor outlet is 90 ppb and the EDC in the reactor inlet is 140 ppb.

Component	Reactor Inlet	Reactor Outlet
Oxygen	8.00%	6.00%
Ethylene Oxide	100 ppm	2.20%
Water	0.25%	0.75%
Carbon Dioxide	4.00%	5.00%
Nitrogen	2.00%	2.00%
Argon	6.00%	6.00%
Methane	50.00%	50.00%
Ethane	0.50%	0.50%
Eyhylene	30.00%	28.00%
1.2-Dichloroethane	2 ppm	n.a
Vinyl Chloride	2 ppm	n.a
Ethyl Chloride	0.1 ppm	n.a

Table 1: Typical EO Stream Compositions (Methane Ballast)

Extrel

Core Mass Spectrometers

ETHYLENE OXIDE

Analysis of an Ethylene Oxide Reactor Outlet Stream Sample

Data	Ethylene		Carbon Dioxide		Ethylene Oxide	
Set	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1	19.1390	0.0064	13.9082	0.0119	1.1624	0.0028
2	19.1501	0.0098	13.9063	0.0145	1.1625	0.0029
3	19.1307	0.0045	13.9136	0.0132	1.1629	0.0027
4	19.1342	0.0069	13.9130	0.0145	1.1623	0.0026
5	19.1303	0.0057	13.9189	0.0150	1.1601	0.0027
6	19.1283	0.0036	13.9142	0.0141	1.1604	0.0026
7	19.1299	0.0081	13.9194	0.0156	1.1584	0.0029
8	19.1305	0.0076	13.9172	0.0154	1.1585	0.0027
9	19.1245	0.0087	13.9102	0.0157	1.1555	0.0027
10	19.1226	0.0087	13.9088	0.0152	1.1549	0.0027
11	19.1301	0.0098	13.9223	0.0179	1.1535	0.0029
12	19.1286	0.0085	13.9366	0.0189	1.1512	0.0027
13	19.1269	0.0093	13.9028	0.0187	1.1532	0.0028
AVG	**19.1312**	**0.0075**	**13.9147**	**0.0154**	**1.1581**	**0.0027**

Table 2: Reactor Outlet Analysis (Nitrogen Ballast)

Carbon Balance Data Collected from Ethylene Oxide Reactors

Time	Reactor One	Reactor Two	Reactor Three	Reactor Four	Reactor Five
2:42	1.003	1.000	0.992	1.022	1.024
3:12	0.997	1.014	1.000	1.017	1.013
3:42	1.000	1.016	1.008	1.0042	1.036
4:13	1.001	1.015	1.005	1.027	1.024
4:41	0.999	1.005	1.002	1.005	1.013
5:11	1.000	1.019	1.014	1.026	1.025
5:41	0.994	1.008	1.001	1.027	1.018
6:12	0.982	1.019	0.999	1.025	1.018
6:42	0.994	1.006	0.996	1.026	1.016
7:13	0.992	1.008	0.992	1.027	1.020
7:43	1.000	1.005	0.992	1.029	1.025
8:11	0.992	1.005	1.001	1.017	1.022
AVG	**0.996**	**1.009**	**1.000**	**1.024**	**1.021**
STD	**0.006**	**0.006**	**0.007**	**0.009**	**0.006**

Repeatability Requirements ± .02

Table 3: Carbon Balance Data

As shown in the tables to the left, Extrel quadrupole mass spectrometers have demonstrated an ability to exceed the ethylene oxide application analysis requirements. The fast and accurate response of the Extrel MAX300 allows the plant to control very close to its optimum set points, improving product yield. If a plant is using a technology with a slower analysis time, such as a gas chromatograph, the control algorithm will have to adjust the set points away from the optimum levels in order to insure safe operation.

Application Background

Ethylene oxide is an intermediate chemical that is used in the production of various products such as films, fibers, polymers, resins, solvents and cleaning solutions. Ethylene oxide is produced by the reaction between ethylene and oxygen over a catalyst at high temperature. The reaction is highly exothermic and for safety and efficiency, the process requires tight control of calculated process parameters including: carbon balance, oxygen balance, conversion rate, carbon efficiency and oxygen efficiency. In addition to maintaining the optimal reactor feeds, the catalyst activity is controlled by the injection of a chlorinated inhibitor such as 1, 2-dichlorethane into the reactor.

Extrel CMS maintains sales and service offices around the world.
Please contact us for the office nearest you or visit our web site at **www.extrel.com**
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