Liquid Effluent Retention Facility Basin 42 Studies

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Abstract:
This report documents laboratory results obtained under test plan RPP-21533 for samples submitted by the Effluent Treatment Facility from the Liquid Effluent Retention Facility Basin 42.

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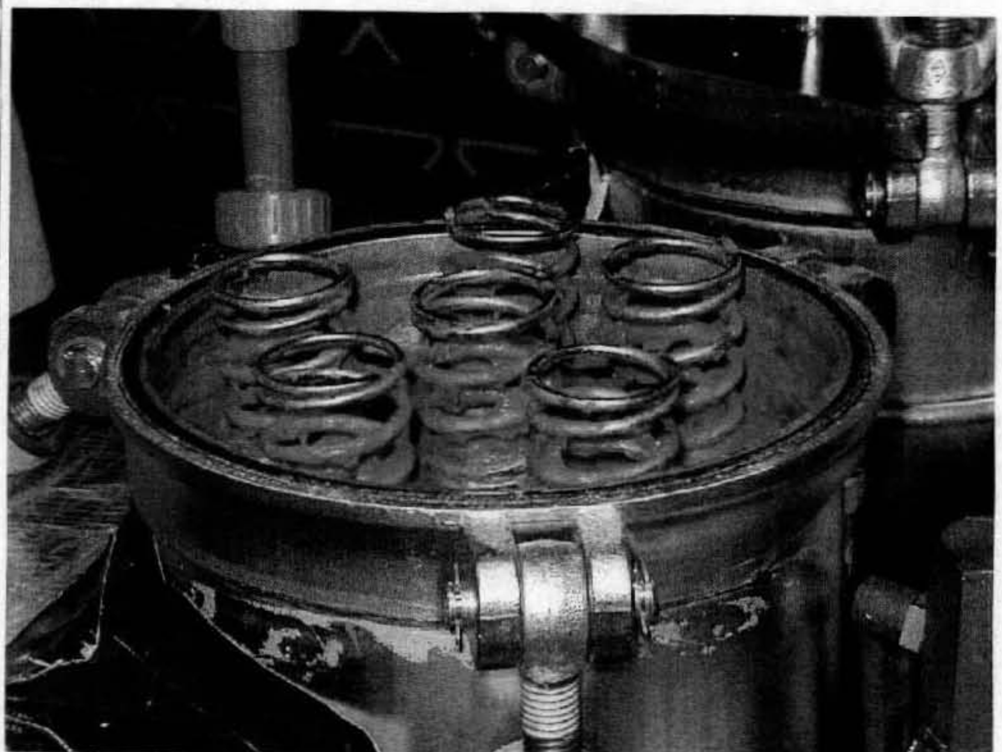
1. INTRODUCTION

This report documents laboratory results obtained under test plan RPP-21533 for samples submitted by the Effluent Treatment Facility (ETF) from the Liquid Effluent Retention Facility (LERF) Basin 42 (Reference 1).

The LERF Basin 42 contains process condensate (PC) from the 242-A Evaporator and landfill leachate. The ETF processes one PC campaign approximately every 12 to 18 months. A typical PC campaign volume can range from 1.5 to 2.5 million gallons. During the September 2003 ETF Basin 42 processing campaign, a recurring problem with "gelatinous buildup" on the outlet filters from 60A-TK-1 (surge tank) was observed (Figure 1). This buildup appeared on the filters after the contents of the surge tank were adjusted to a pH of between 5 and 6 using sulfuric acid. Biological activity in the PC feed was suspected to be the cause of the gelatinous material. Due to this buildup, the filters (10 µm CUNO[1]) required daily change out to maintain process throughput.

Figure 1. Slime Buildup Inside the Filter Housing During Basin 42 Campaign.



[1] CUNO is a registered trademark of CUNO Incorporated, Meriden, Connecticut.

ETF personnel obtained the sample material received at the 222-S Laboratory, which was taken from Riser 2 of Basin 42 at the 3-foot level. The samples arrived in three 3-gallon carboys (approximately 9 gallons). The material was clear and had a definite odor of an ammonia/amine mixture. Aliquots from each carboy were submitted for pH and analyses using ion chromatography and inductively coupled plasma spectrometry. The results are presented in Appendix A.

The field observations could not be reproduced in the laboratory. Therefore, it was not possible to collect data concerning filtration of gelatinous material. However, microbial counts were carried out as well as glutaraldehyde demand and glutaraldehyde microbial kill curves. The glutaraldehyde demand and kill curves were carried out at the as-received pH (9.46) and an adjusted pH of 5.8. An aliquot was also filtered through 0.45-µm cellulose acetate and examined under the scanning electron microscope (SEM) in an attempt to identify material that may cause filtration problems.

2. MATERIAL AND METHODS

2.1 INITIAL MICROBIAL COUNTS

On receipt of the samples, initial microbial counts were performed using Biotrace[2] dipslides containing nutrient agar with 2,3,5-triphenly tetrazolium chloride, an indicator dye for viable microorganisms. After incubating at room temperature for 4-5 days, microbe counts ranging from 10^4-10^5 colony forming units per milliliter (CFU/mL) were obtained, not unsimilar to populations found in natural environments (Reference 2). Taxonomic classification was not carried out as that effort was beyond the scope of the program.

2.2 GLUTARALDEHYDE DEMAND

Glutaraldehyde, a commercially available broad spectrum biocide, is commonly used in industry to control the growth of microorganisms including slime-forming bacteria in process waters (Reference 3). As a reactive chemical, there will be a demand generated by the matrix. Glutaraldehyde demand was established using 500 mL of sample at both pH levels, as received (pH 9.46) and pH 5.8. Glutaraldehyde was introduced to each beaker at 52 ppm and confirmed using Glutatect test kits (Glutatect WT[3] colorimetric test for 20 to 100 ppm and Glutatect ENV[4] colorimetric test for 2 to 10 ppm glutaraldehyde).

The sample was continually stirred during the course of the experiment using a magnetic mixer. Aliquots were retrieved initially at 0.25 minutes (the time needed for the introduction of the glutaraldehyde and sampling with the Glutatect kit). After the initial and 0.25-minute reading, glutaraldehyde testing occurred every 5 minutes after the initial introduction of glutaraldehyde.

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[2] Biotrace is a registered product of Biotrace International Plc, Bridgend Wales, United Kingdom.
[3] Glutatect WT is a registered trademark of Alden Scientific, Inc., Winthrop, Massachusetts.
[4] Glutatect ENV is a registered trademark of Alden Scientific, Inc., Winthrop, Massachusetts.

2.3 MICROBIAL KILL

An inoculum was derived from bacterial growth on the initial dipslides. The newly inoculated dipslide was allowed to establish colonies, which were eluted using Basin 42 sample. The resulting concentration was introduced into 500-mL aliquots of Basin 42 at pH 9.46 and pH 5.8. Glutaraldehyde was introduced at concentrations of 60 ppm (as tested by the Glutatect method). Microbial counts were established using the dipslides described in Section 2.1 at the initial time (before glutaraldehyde introduction), time 0, time of glutaraldehyde introduction, and 5 minutes thereafter.

2.4 SCANNING ELECTRON MICROSCOPY

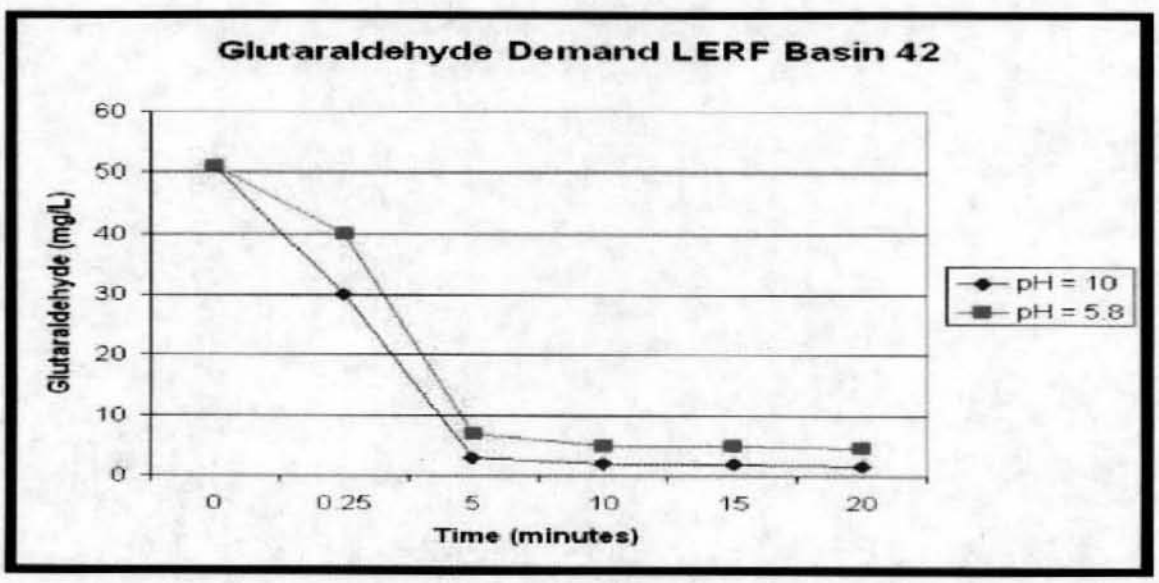
Two hundred milliters of Basin 42 were filtered through a 0.45-µm cellulose acetate filter and scanned using SEM. The SEM analysis also included electron dispersive X-ray spectroscopy (EDS) for elemental analyses.

3. RESULTS AND DISCUSSION

3.1 GLUTARALDEHYDE DEMAND

Figure 2 shows the results of the glutaraldehyde demand curve described in Section 2.2.

Figure 2. Glutaraldehyde Demand.



The graph indicates that the glutaraldehyde acts faster at the higher pH. Therefore, if ETF uses glutaraldehyde as a biocide, it would be advisable to do so before pH adjustment is carried out in the surge tank.

3.2 MICROBIAL KILL

Figure 3 shows the efficacy of glutaraldehyde in the Basin 42 matrix at pH 9.46 and ph 5.8.

Figure 3. Basin 42 Microbial Response to Glutaraldehyde.

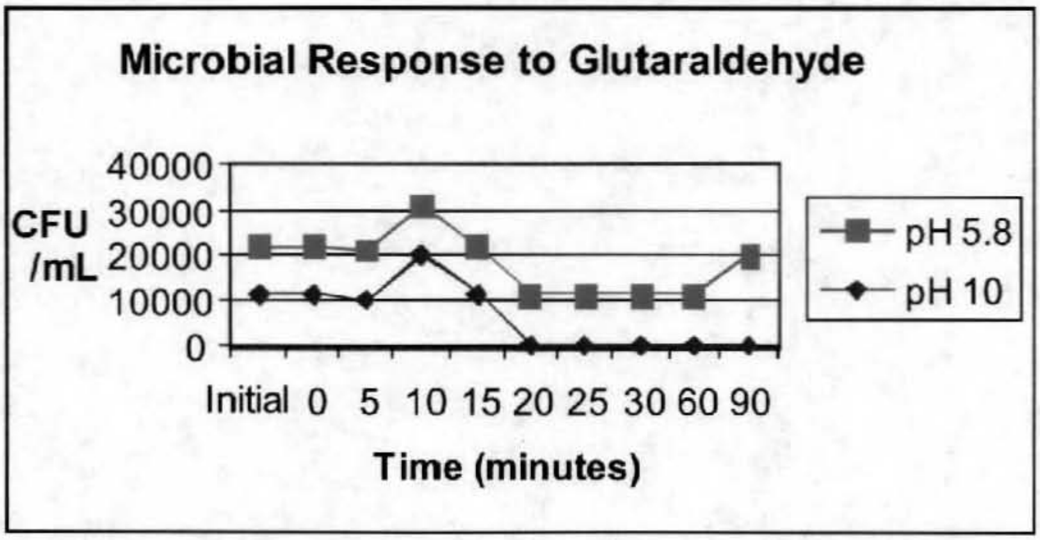


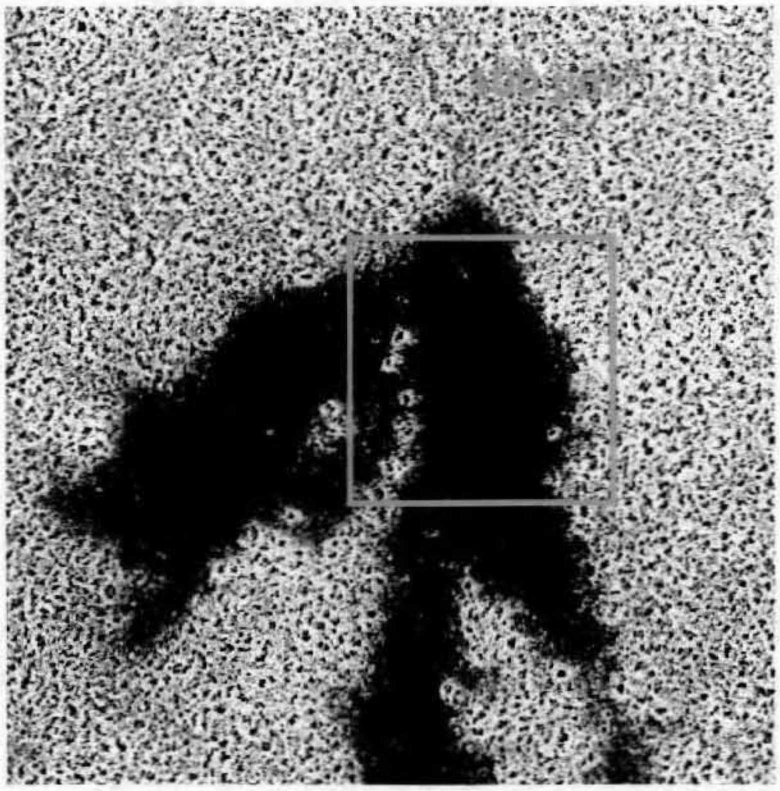
Figure 3 indicates the efficacy of glutaraldehyde as a biocide at the higher pH range. Again, if the ETF wishes to employ glutaraldehyde as a biocide, the glutaraldehyde will be more efficacious at the as-received pH versus the adjusted pH.

3.3 SCANNING ELECTRON MICROSCOPY

Figure 4 is a SEM photo of material trapped on the influent side of a 0.45-µm filter.

The material appearing black is an amorphous mass that was trapped on the surface of the 0.45-µm filter. The material within the box was interrogated using EDS without firm results. The area indicated carbon, hydrogen, and oxygen; essentially elements found in hydrocarbons or living organisms.

Figure 4. SEM of Basin 42 Filter Retentate on 0.45-Micron Filter.



4. CONCLUSIONS AND RECOMMENDATIONS

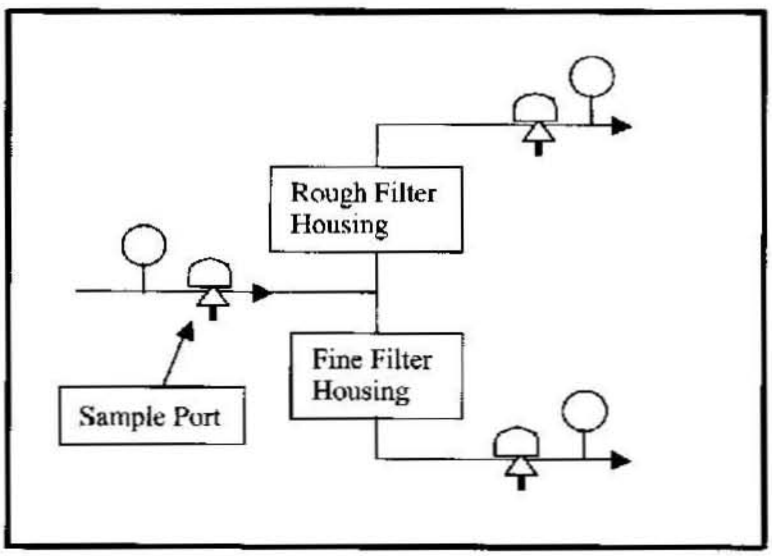
This report indicates the efficacy of glutaraldehyde as a biocide in more alkaline pH as opposed to the adjusted acidic pH that ETF requires for their process. At first it was thought that the response of Basin 42 was perhaps due to the particular matrix and colligative properties associated with the matrix. It is unfortunate that the field observations could not be reproduced in the laboratory. This inability did not allow for filtration runs to be performed. This inability to secure a sample that would act the same is probably indicative of the problem being localized in an area of the basin that allows for transfer during pumping but not during sampling. It is recommended that if the gelatinous material occurs during the next campaign, a sample of the gelatinous material be submitted to 222-S Laboratory for analyses to determine the cause.

It has been requested that a filter recommendation be put forth that would enable longer filter runs when confronted with the gelatinous material as in the last Basin 42 campaign. Before launching into a recommendation, it should be stated that gelatinous material encountered in filtration processes is individual in nature; i.e., not all gels are created equal nor react equally in filtration unit operations. Also, any filtration media should have the ability to be retrofitted to existing housing. The following recommendation is based on *a priori* processes.

CUNO Incorporated has reviewed the nature of the gelatinous material inasmuch as photos from the last campaign are able to indicate. After numerous discussions with CUNO technical support and field personnel, the recommendation by the vendor is the CUNO PolyNet.[5] The PolyNet (Appendix B) is a depth filter designed to filter high viscosity materials in the petroleum industry. Due to the nature of the gelatinous material as shown in the photographs, CUNO recommended a run time to a delta of ~10 psi, then either a backwash or cleaning using hot water (140 °F). (The usual recommended delta P is 80 psi @ 68 °F.) The reason for the lower delta P is to enable cleaning of the filter before the gelatinous material is driven too far into the filter. Also, operating at high delta P's (outside of the manufacturer's recommendation) will degrade the effluent stream by pushing material through the filter.

In addition, CUNO has recommended that the Pall ProSep[6] fine filters also be replaced with the PolyNet. The replacement would be 36 PolyNet filters with a maximum flow rate of 648 gpm. Currently CUNO is preparing a cost proposal for a retrofit filter basket to fit within the existing housing. If agreeable with ETF management, the rough filter housing containing PolyNet filters could be operated in parallel with the fine filter housing containing the ProSep filters. A suggested test configuration is presented in Figure 5 to allow comparative analyses of influent and effluent streams.

Figure 5. Suggested Test Configuration for PolyNet and ProSep Filters.



[5] PolyNet is a registered trademark of CUNO Incorporated, Meriden, Connecticut.
[6] ProSep is a registered trademark of Pall Corporation, East Hills, New York.

5. REFERENCES

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2. Smith, J. J., and J. C. Priscu, 1993, "Microbial respiration potential in Lake Bonney using a novel tetrazolium-reduction method," *Antarctic Journal of the U.S.* 28(5): 244-245.

3. Ganzer, G. A., 2001, "Glutaraldehyde: A versatile microbiocide for use in water treatment applications," *Analyst*, Spring 2001.

APPENDIX A

Chemical Analyses

Chemical Analyses LERF Basin 42

Analyte	Unit	Result	Detection Limit
pH Direct	pH	9.46	0.01
TIC by Acid/Coulometry	µg/mL	20.4	2.5
TOC by Persulfate/Coulometry	µg/mL	<20.0	20
Technetium-99 by ICP/MS (Acid Addition)	µg/mL	3.49E-06	1.50E-06
Tin-126 by ICP/MS (Acid Addition)	µg/mL	<1.00E-06	1.00E-06
Cesium-133 by ICP/MS Acid Addition	µg/mL	1.39E-05	1.00E-05
Cesium-135 by ICP/MS Acid Addition	µg/mL	3.10E-04	7.50E-06
Cesium-137 by ICP/MS (Acid Addition)	µg/mL	5.60E-04	4.50E-06
Protactinium-231 by ICP/MS	µg/mL	<5.00E-08	5.00E-08
Thorium-229 by ICP/MS	µg/mL	<9.00E-08	9.00E-08
Thorium-230 by ICP/MS	µg/mL	<7.00E-08	7.00E-08
Thorium-232 by ICP/MS	µg/mL	1.79E-05	1.20E-06
Uranium-233 by ICP/MS Acid Addition	µg/mL	<9.00E-08	9.00E-08
Uranium-234 by ICP/MS Acid Addition	µg/mL	1.19E-06	3.00E-08
Uranium-235 by ICP/MS Acid Addition	µg/mL	1.56E-04	1.10E-07
Uranium-236 by ICP/MS Acid Addition	µg/mL	1.98E-06	4.00E-08
Uranium-238 by ICP/MS Acid Addition	µg/mL	0.0222	5.50E-06
Neptunium-237 by ICP/MS	µg/mL	2.02E-06	2.70E-07
Plutonium-239 by ICP/MS	µg/mL	2.85E-06	6.00E-07
Plutonium-240 by ICP/MS	µg/mL	<5.00E-08	5.00E-08
Plutonium/Americium-241 by ICP/MS	µg/mL	<3.50E-07	3.50E-07
Plutonium/Americium 242 ICP/MS (Acid Added)	µg/mL	<4.00E-08	4.00E-08
Americium 243/Cerium 243 by ICP/MS	µg/mL	<5.00E-08	5.00E-08
Plutonium 244/Cerium 244 by ICP/MS	µg/mL	<9.00E-08	9.00E-08
Silver-ICP-Acid Dilution	µg/mL	9.26E-03	5.00E-03
Aluminium-ICP-Acid Dilution	µg/mL	<0.0800	0.08
Arsenic-ICP-Acid Dilution	µg/mL	<0.0400	0.04
Boron-ICP-Acid Dilution	µg/mL	0.0175	9.00E-03
Barium-ICP-Acid Dilution	µg/mL	<5.00E-03	5.00E-03
Beryllium-ICP-Acid Dilution	µg/mL	<4.00E-03	4.00E-03
Bismuth-ICP-Acid Dilution	µg/mL	<0.0600	0.06
Calcium-ICP-Acid Dilution	µg/mL	5.92	0.02
Cadmium-ICP-Acid Dilution	µg/mL	<4.00E-03	4.00E-03
Cerium-ICP-Acid Dilution	µg/mL	<0.0250	0.025
Cobalt-ICP-Acid Dilution	µg/mL	<6.00E-03	6.00E-03
Chromium-ICP-Acid Dilution	µg/mL	<2.50E-03	2.50E-03
Copper-ICP-Acid Dilution	µg/mL	7.38E-03	2.00E-03
Europium ICP-Acid Dilution	µg/mL	<0.0150	0.015
Iron-ICP-Acid Dilution	µg/mL	0.0134	2.50E-03
Potassium-ICP-Acid Dilution	µg/mL	0.728	0.45
Lanthanum-ICP-Acid Dilution	µg/mL	<3.50E-03	3.50E-03

Analyte	Unit	Result	Detection Limit
Lithium-ICP-Acid Dilution	µg/mL	<4.00E-03	4.00E-03
Magnesium-ICP-Acid Dilution	µg/mL	1.35	0.025
Manganese-ICP-Acid Dilution	µg/mL	<5.00E-03	5.00E-03
Molybdenum-ICP-Acid Dilution	µg/mL	<8.00E-03	8.00E-03
Sodium-ICP-Acid Dilution	µg/mL	18.1	0.04
Neodymium-ICP-Acid Dilution	µg/mL	<0.0100	0.01
Nickel-ICP-Acid Dilution	µg/mL	<0.0200	0.02
Phosphorus-ICP-Acid Dilution	µg/mL	0.147	0.045
Lead-ICP-Acid Dilution	µg/mL	<0.0300	0.03
Sulfur-ICP-Acid Dilution	µg/mL	37.4	0.03
Antimony-ICP-Acid Dilution	µg/mL	<0.0250	0.025
Selenium-ICP-Acid Dilution	µg/mL	0.0488	0.04
Silicon-ICP-Acid Dilution	µg/mL	4.3	0.015
Samarium-ICP-Acid Dilution	µg/mL	<0.0150	0.015
Strontium-ICP-Acid Dilution	µg/mL	0.0236	4.00E-03
Thorium-ICP-Acid Dilution	µg/mL	<0.0250	0.025
Titanium-ICP-Acid Dilution	µg/mL	<2.00E-03	2.00E-03
Thallium-ICP-Acid Dilution	µg/mL	<0.100	0.1
Uranium-ICP-Acid Dilution	µg/mL	<0.0550	0.055
Vanadium-ICP-Acid Dilution	µg/mL	9.62E-03	5.00E-03
Yttrium -ICP-Acid Dilution	µg/mL	<4.00e-03	4.00E-03
Zinc-ICP-Acid Dilution	µg/mL	<5.00e-03	5.00E-03
Zirconium-ICP-Acid Dilution	µg/mL	<5.00E-03	5.00E-03
Fluoride-IC-Dionex 500 Coulometry	µg/mL	<0.330	0.33
Glycolate-IC-Dionex 500 ORGACD	µg/mL	<2.09	2.1
Acetate by IC-Dionex 500 Coulometry	µg/mL	<2.53	2.5
Formate by IC-Dionex 500 Coulometry	µg/mL	<2.53	2.5
Chloride-IC-Dionex 500 Coulometry	µg/mL	4.59	0.44
Nitrite-IC-Dionex 500 Coulometry	µg/mL	<2.97	3
Sulfate-IC-Dionex 500 Coulometry	µg/mL	111	3.5
Oxalate-IC-Dionex 500 Coulometry	µg/mL	<2.97	3
Bromide-IC-Dionex 500 Coulometry	µg/mL	<3.19	3.2
Nitrate-IC-Dionex 500 Coulometry	µg/mL	4.74	3.3
Phosphate-IC-Dionex 500 Coulometry	µg/mL	<2.97	3

Legend:

IC ion chromatography
ICP inductively coupled plasma spectroscopy
MS mass spectroscopy
TIC total inorganic carbon
TOC total organic carbon

APPENDIX B

CUNO PolyNet Specifications

PolyNet®

CUNO®

Filter Cartridges

The Next Generation in Depth Filtration Technology

Featuring

- Advanced media configuration enhances flow while providing extended service life.
- Absolute rated from 0.5 to 70 μm to provide consistent filtration for a broad range of applications.
- All Polypropylene construction for process compatibility

PolyNet® Filter Cartridges

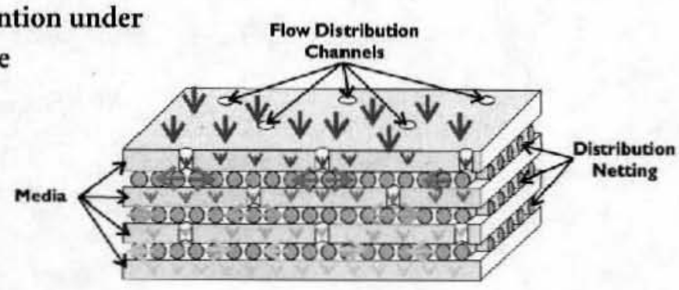
The Next Generation In Depth Filter Technology

PolyNet filter cartridges are CUNO'S latest advance in depth filtration technology. The all polypropylene filter is constructed using a patented design that utilizes flow enhancing filter media and an innovative flow pattern. The result is an absolute-rated filter with vastly superior on-stream life that provides more cost effective filtration than conventional melt-blown filter technologies. PolyNet filter cartridges* ***- the new leader in filtration performance!***

The PolyNet Advantage

- **Superior Service Life - as much as 4 times greater dirt holding capacity than competitive filters**
- **All polypropylene depth filter cartridges for broad chemical and temperature compatibility**
- **Ratings from 0.5 - 70 microns to suit a wide range of applications**
- **Absolute-Rated Performance for consistent filtration quality**
- **Exhibits superior particle retention under increasing differential pressure**

PolyNet Filter Construction



CUNO designed the PolyNet cartridge to provide *significantly* superior service life while maintaining a consistent filtration efficiency. PolyNet filters achieve this through an innovative cartridge design that allows uniform distribution of fluid flow *and* contaminant throughout the entire depth of the cartridge. PolyNet filter construction combines a unique polypropylene media with fluid distribution netting to form multiple layers. Critically positioned media flow channels allow greater movement of fluid from layer to layer. Three distinct media sections, made from multiple media/netting layers, are combined to form the filter cartridge.

The outer and middle sections contain multiple layers of interleaved filter media and fluid distribution netting. Within each media layer a portion of the fluid travels through the media while the balance of the fluid is delivered directly to the next distribution layer through the flow channels. The fluid distribution netting provides longitudinal and latitudinal flow paths to evenly distribute fluid flow across the surface of each successive media layer.

* US Patent 6,391,200

PolyNet® Filter Cartridges

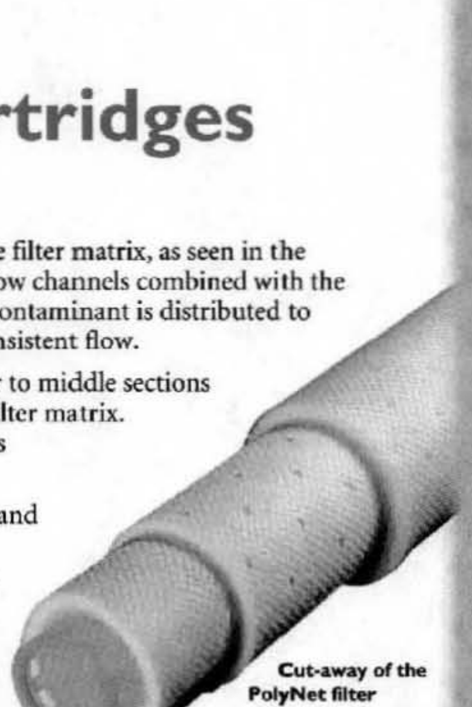
The Difference is Performance

Flow channels appear in the outer and middle sections of the filter matrix, as seen in the cartridge cut-away. The size, number, and location of the flow channels combined with the fluid distribution netting ensure that a uniform amount of contaminant is distributed to each layer within these two sections, while maintaining a consistent flow.

The number of media flow channels decrease from the outer to middle sections to ensure even contaminant loading throughout the entire filter matrix. Extensive laboratory testing has demonstrated that Cuno has developed the optimal filter cartridge design.

The inner section, supported by a rigid polypropylene core and equal to approximately one third of the filter's depth, contains no flow channels and is the final qualifying section ensuring absolute rated performance.

The even distribution of contaminated fluid throughout the depth of the cartridge is the key to PolyNet filters exceptionally long service life, low pressure drop, and increased cost effectiveness.



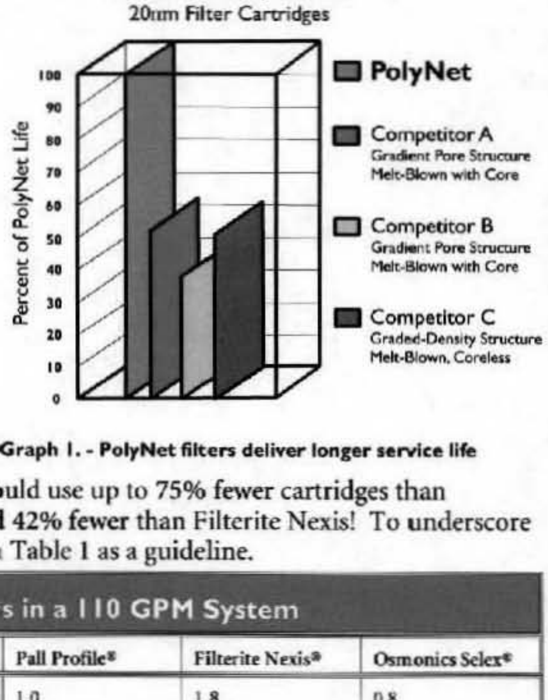
Cut-away of the PolyNet filter cartridge showing the three sections of media layers and core

The Result

Superior Filter Service Life

Extensive testing has demonstrated that competitive filters of equivalent removal ratings subjected to the same contaminant load plug more quickly than PolyNet filters. The result is significantly shorter service life, and unpredictable filtration efficiencies. PolyNet filters provide a service life improvement of **up to 3 times greater than competitive products!** (Graph 1)

Service Life Comparison of 20nm Filter Cartridges



Graph 1. - PolyNet filters deliver longer service life

Lower Pressure Drop

The unique design and construction of the PolyNet cartridge allow for significantly lower pressure drops compared to equivalently rated melt-blown depth filters. Based on published data, a PolyNet filter system with a given flow would use up to **75% fewer** cartridges than Osmonics Selex, **68% fewer** than Pall Profile, and **42% fewer** than Filterite Nexis! To underscore the PolyNet filter cost benefit, use the example in Table 1 as a guideline.

Table 1. - Comparison of 5 Micron* Filters in a 110 GPM System

	PolyNet Filters	Pall Profile®	Filterite Nexis®	Osmonics Selex®
Flow (gpm) / 10" cartridge @ 1 psid	3.1	1.0	1.8	0.8
Number of filters for a 110 gpm flow rate	12 / 30" cartridges	37 / 30" cartridges	21 / 30" cartridges	43 / 30" cartridges

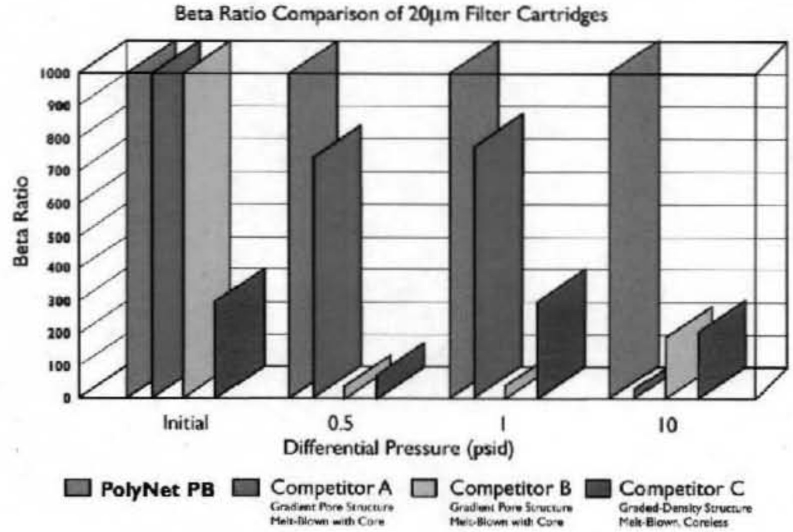
* Based on the manufacturers published rating.

For the same initial cartridge differential pressure, a 110 gpm system using PolyNet filters require significantly fewer cartridges. This results in lower capital investment for the filter housing and fewer cartridges to purchase.

PolyNet® Filter Cartridges

The Confidence of Consistency

PolyNet filters utilize advanced design and construction to achieve a level of filtration consistency unattainable by competitive filters. Combined with an exceptionally long service life, the PolyNet filter's consistent performance, as illustrated by comparative Beta-Ratio vs. Differential Pressure (Graph 2), provides predictable results throughout the usable filter life. Filters A, B, and C show a degradation in the Beta-Ratio as psid increases. ***These filters exhibit a pattern of either unloading previously held particles or a loss of filtration efficiency.*** The result of this inconsistent performance is a reduction in finished product quality, product yield, and an increase in total filtration cost!



Graph 2. - Beta Ratios demonstrate the PolyNet filter's ability to perform consistently throughout its life

Absolute PolyNet

Consistent filtration performance, time after time, from start to finish - the goal of every filter user, the solution provided by PolyNet filters! Absolute removal ratings for PolyNet filters are determined using a filter performance test developed by CUNO to comply with the general procedures outlined in ASTM STP 975. CUNO defines absolute rating as the particle size (x) providing an initial Beta Ratio (B_x) = 1000. At this Beta Ratio, the removal efficiency is equal to 99.9%. PolyNet filter ratings are specified in Table 2.

Table 2. - PolyNet Filter Ratings

Grade Designation	Absolute Rating (Microns)
T005	0.5*
T010	1
T020	2
T030	3
T050	5
T100	10
T200	20
T300	30
T400	40
T500	50
T700	70

* extrapolated

Your Benefit - Total Filtration Cost Reduction

The PolyNet filter's performance and superior life advantage allow direct cost savings by reducing the number of filters used. In addition, the resulting reduction in filter change-out frequency decreases direct labor and filter disposal costs. **PolyNet filter cartridges - providing performance and value!**

PolyNet® Filter Cartridges

PolyNet Filter Applications

PolyNet's unique patented construction provides benefits to customers in a wide range of end-use filtration applications. High quality filtration along with total filtration cost reductions are very attractive benefits to customers in diverse industries.

Chemical and Hydrocarbon Processing Applications - Cost reduction is the most critical issue in the production of high quality chemicals, petrochemicals, and in hydrocarbon processing. Using PolyNet filters in demanding applications that require absolute-rated performance provides long service life, the consistency demanded to attain quality standards, and a total Filtration Cost reduction! Applications include:

- **Acids, bleach (sodium hypochlorite)**
- **Polyethylene and polypropylene manufacture**
- **Amine sweetening and waterflood**

Food & Beverage Applications - Increased consumer emphasis on product quality, as well as increased government regulation, are driving today's food & beverage industry to ever-finer levels of filtration. PolyNet filter cartridges meet this challenge throughout their entire service life. Typical applications include:

- **Bottled water particulate and turbidity reduction**
- **Reverse osmosis membrane and spray nozzle protection**
- **Diatomaceous earth or carbon fine trap**
- **Beverage blending, rinsing, or wash water**

Fine Chemical and Electronics Applications - PolyNet filters with their unique filter matrix are ideally suited for electronics applications where heavy contaminant loading is present and efficient long lasting filtration is required. The combination of all-polypropylene construction and the unique media provide the perfect filtration device for use in wafer manufacturing and semiconductor device fabrication. Applications include:

- **Pre-RO filtration of high silt density index incoming water**
- **Copper sulfate plating bath filtration in printed circuit board construction**
- **Color screen filtration for CRT production**

Coating Applications - PolyNet filter cartridges are well suited for the filtration of high solid coatings where they provide superior life while selectively removing the large undesired particles from the coating and allowing the smaller desired particles to pass. PolyNet applications include:

- **Film & paper coatings**
- **Photographic film**
- **Lens coatings & magnetic media**
- **Can coatings, high quality paints, & ink**

Industrial Applications - PolyNet filter cartridges are ideal for higher dirt loads because of the unique flow characteristics and long service life that provide reduced overall filtration costs. PolyNet cartridges are used in a broad range of general industrial applications that include:

- **Machine tool lubrication, chemicals, detergents, and waste water**
- **Textiles, plating baths**
- **Pulp & paper**
- **Process water & ground water remediation**

Cuno Filter Housings

Cuno manufactures a wide range of filter housings. Housings that accommodate from a single filter element, to many hundreds, available in a broad choice of materials, and a flexibility of design ensure that Cuno has a filter housing to suit your needs.

ES Series Filter Housing - The ES Series filter housing is a durable high volume filter housing constructed from 316L stainless or carbon steel. With a cartridge capacity from 12 to 480 equivalent lengths, the ES filter can accommodate a wide range of flow requirements. For more information, ask your local Cuno distributor for brochure LITCHSES1.

CTG-Klean® Filter Housing - A unique design provides a totally enclosed system using separate pressure vessel and filter pack to isolate process fluid from the housing. This system virtually eliminates the costs involved with filter change-out while protecting the environment and operator from exposure to the process fluid. For more information, ask your local Cuno distributor for brochure LITCCK001.

DC & SD Filter Housings - DC and SD filter housings offer a cost effective alternative for low volume filtration. Constructed from reliable 304L stainless steel (Model DC) or 316L stainless steel (Model SD), systems are available for a wide range of flow rates and applications. For more information, ask for literature LITHSDC1 and LITHSSD1.

PolyNet® Specifications

Materials of Construction*	
Filter Media, Netting, Core, End Connector	Polypropylene
Gaskets & O-ring Options (see ordering guide)	Silicone, Fluorocarbon, EPR, Nitrile, Teflon Encapsulated Viton, and Polyethylene

Operating Conditions	
Maximum Operating Temperature	180° F (82°C)
Maximum Differential Pressure	50 psid at 86°F (3.4 bar at 30°C) 30 psid at 131°F (2.0 bar at 55°C) 15 psid at 180°F (1.0 bar at 82°C)
Recommended Change-Out Differential Pressure	35 psid at 86°F (2.4 bar at 30°C)

Cartridge Dimensions	
Inside Diameter	1 3/32" nominal
Outside Diameter	2 ½" nominal
Length	5, 9 ¾, 10, 19 ½, 20, 29 ¼, 30, 39, and 40 inches

* All materials are FDA compliant per 21 CFR, Teflon and Viton are registered trademarks of E. I. du Pont de Nemours and Company.

Flow Rates

Flow vs. differential pressure in water is depicted for each PolyNet filter grade in the graph below. Detailed information for calculating flows for fluids with other viscosities is located in the following table. Use the formula in conjunction with the values from columns 3 or 4 in the table. The specific pressure drop values may be effectively used when three of the four variables (viscosity, flow, differential pressure, and cartridge grade) are set.

$$\text{Clean } \Delta p \text{ psi (mbar)} = \frac{\left(\text{Total system gpm [lpm]}\right)\left(\text{Viscosity in Cp}\right)\left(\text{Value from table}\right)}{\left(\text{Number of Equivalent Single Length Cartridges in housing}\right)}$$

PolyNet Flow Rates

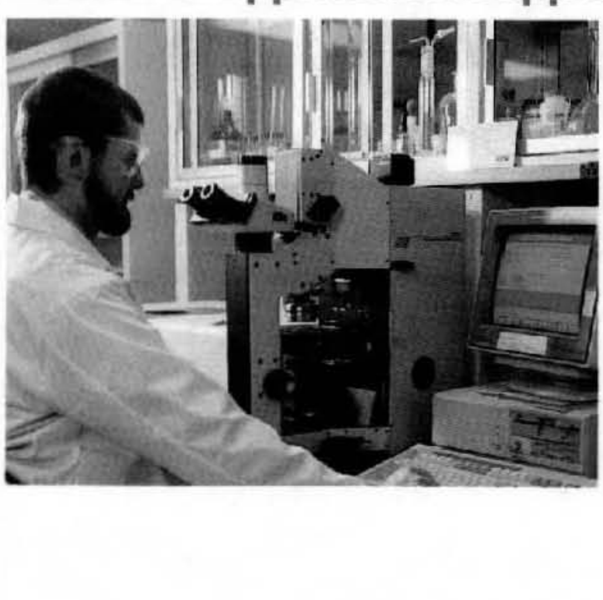
Grade	Absolute Rating (µm)	Specific Pressure Drop per 10" Cartridge*	
		psid/gpm/cps	mbar/lpm/cps
T005	0.5	4.5	81.9
T010	1	2.5	45.5
T020	2	0.87	15.9
T030	3	0.44	8.0
T050	5	0.32	5.9
T100	10	0.14	2.5
T200	20	0.065	1.2
T300	30	0.05	0.91
T400	40	0.042	0.76
T500	50	0.029	0.52
T700	70	0.025	0.45

* Specific aqueous pressure drop at ambient temperature for a single length equivalent (10") cartridge. For multiple cartridge lengths, divide the total flow by the number of equivalent lengths. For liquids other than water, multiply the specific pressure drop value provided in the table by the viscosity in centipoise.

Chemical Compatibility

The 100% polypropylene construction provides excellent chemical compatibility in many demanding process fluid applications. Compatibility is influenced by process operating conditions: in critical applications, cartridges should be tested under actual conditions to ensure correct selection.

Scientific Application Support Services (SASS)

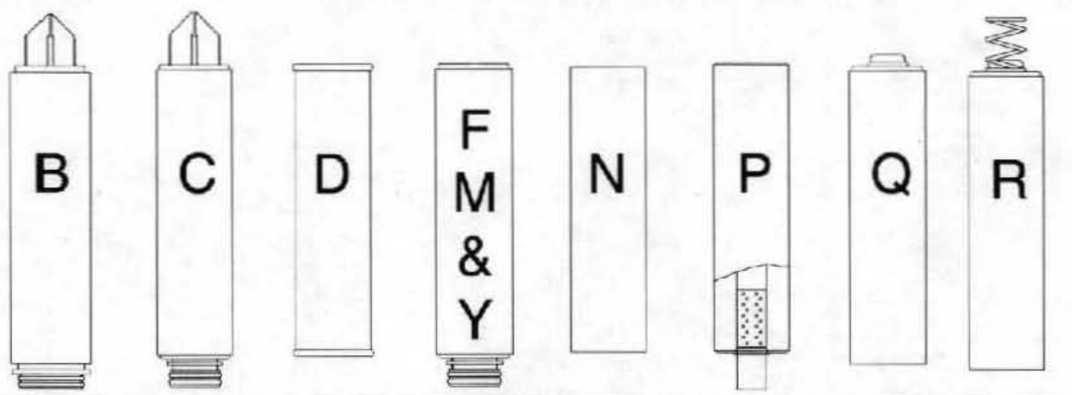


Dedicated technical support teams comprised of Cuno scientists and engineers are available to provide application specific recommendations for the most effective and economical filtration system. In addition to comprehensive testing and analysis conducted at Cuno's advanced laboratories, the SASS staff frequently performs on-site testing at customer's facilities. Contact you Cuno representative for additional information.

PolyNet® Ordering Guide

Cartridge Type	Length (inches)	Grade Code	Grade Rating (µm)	Packaging Option	Support Ring Option	End Modification (see illustration below)	Gasket/O-ring Material
NT = PolyNet	06† - 5	T005	0.5	S - Standard	For End Modification	B - 226 O Ring with Spear	For End Modification
	09 - 9 ¾ *	T010	1		D, N, P, Q, & R	C - 222 O-Ring with Spear	B, C, D, F, M, & Y
	10 - 10	T020	2		0 - None	D - DOE with Polypropylene	A - Silicone
	19 - 19 ½ *	T030	3		For End Modification	End Caps	B - Fluorocarbon
	20 - 20	T050	5		B, C, F, M & Y	F - 222 O-Ring with Flat Cap	C - EPR
	29 - 29 ¼ *	T100	10		1 - Polysulfone	M - 222 O-Ring with Flat Cap**	D - Nitrile
	30 - 30	T200	20		2 - Stainless Steel	N - Unmodified DOE	K - Teflon Encapsulated
	39 - 39 *	T300	30		0 - None	P - Polypropylene Core Extender	Viton O-Ring
	40 - 40	T400	40			Q - SOE, End Cap without Spring	For End Modification
		T500	50			R - SOE, End Cap with Spring	N, P, Q, & R
		T700	70			Y - Single O-ring (40" length only)	G - Polyethylene

† Requires N end modification for use in CT101 (PN 44860) only * Applies to D, N, and P end modifications only ** for use with 1ZMP housing



WARRANTY

Seller warrants its equipment against defects in workmanship and material for a period of 12 months from date of shipment from the factory under normal use and service and otherwise when such equipment is used in accordance with instructions furnished by Seller and for purposes disclosed in writing at the time of purchase, if any. Any unauthorized alteration or modification of the equipment by Buyer will void this warranty. Seller's liability under this warranty shall be limited to the replacement or repair, F.O.B. point of manufacture, of any defective equipment or part which, having been returned to the factory, transportation charges prepaid, has been inspected and determined by the Seller to be defective. THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EITHER EXPRESSED OR IMPLIED, AS TO DESCRIPTION, QUALITY, MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR USE, OR ANY OTHER MATTER. Under no circumstances shall Seller be liable to Buyer or any third party for any loss of profits or other direct or indirect costs, expenses, losses or consequential damages arising out of or as a result of any defects in or failure of its products or any part or parts thereof or arising out of or as a result of parts or components incorporated in Seller's equipment but not supplied by the Seller.

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