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BADGER ARMY AMMUNITION PLANT

OLIN CORPORATION

ENERGY SYSTEMS DIVISION

BARABOO, WISCONSIN

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6

DESIGN COMPARISON OF CONTINUOUS NITRATORS

Biazzi

Hanspeter Moser

Nitro Nobel

Basis: A Continuous Facility of 1,600 PPH of Nitroglycerin

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	Biazzi	Hanspeter Moser	Nitro Nobel
A. Nitrator			
1. Nitrator Type	Stirred Reactor Vessel	Stirred Reactor Vessel	Injector Mixing Tee
2. Nitrator Capacity	30 Gallons	20 Gallons	½ Gallon
3. Nitrator Power	15 hp Electric Motor	20 hp Hydraulic Drive Turbine	None
4. Nitrator RPM	540 rpm (Exits at 5 ft/sec)	~ 600 rpm	2.6 ft/sec Out of Tee
5. Nitration Temperature	16° C.	20° C.	47° C.
6. Nitrator Cooling	5 Spiral Brine Coils in Nitrator	Vertical Hairpin Brine Coils in Nitrator	50 Gallon Spiral Cooler Located Below Tee
7. Retention Time in Nitrator	6 Minutes	~ 4 Minutes	3 Seconds
8. Retention Time in Cooler	-	-	3 Minutes
9. NG Content at Any One Time	160 Pounds	~ 130 Pounds	~ 60 Pounds
10. Cooling Surface	150 ft^2	~ 100 ft^2	160 ft^2 in Spiral Cooler
11. Drowning Time	15 Seconds	5 Seconds	3 Minutes
B. Control of Nitrator			
1. Mixed Acid Feed Method	Volumetric gear pump from shift feed tank.	Volumetric pump from shift feed tank.	Pumped through control valve and flowmeter.
2. Adjustment of Acid Feed	Variator on pump motor with flowmeter indicator.	Variable gear system with magnetic flowmeter.	Control valve.
3. Glycerin Feed Method	Same as acid.	Same as acid.	Sucked from feed tank by injector.
4. Adjustment of Feed	Variator between glycerin pump and acid pump with flowmeter indicator.	Second gear system connected to acid pump gear system and pumped through flowmeter.	Controlled by rate acid goes through injector and goes through control valve and meter.

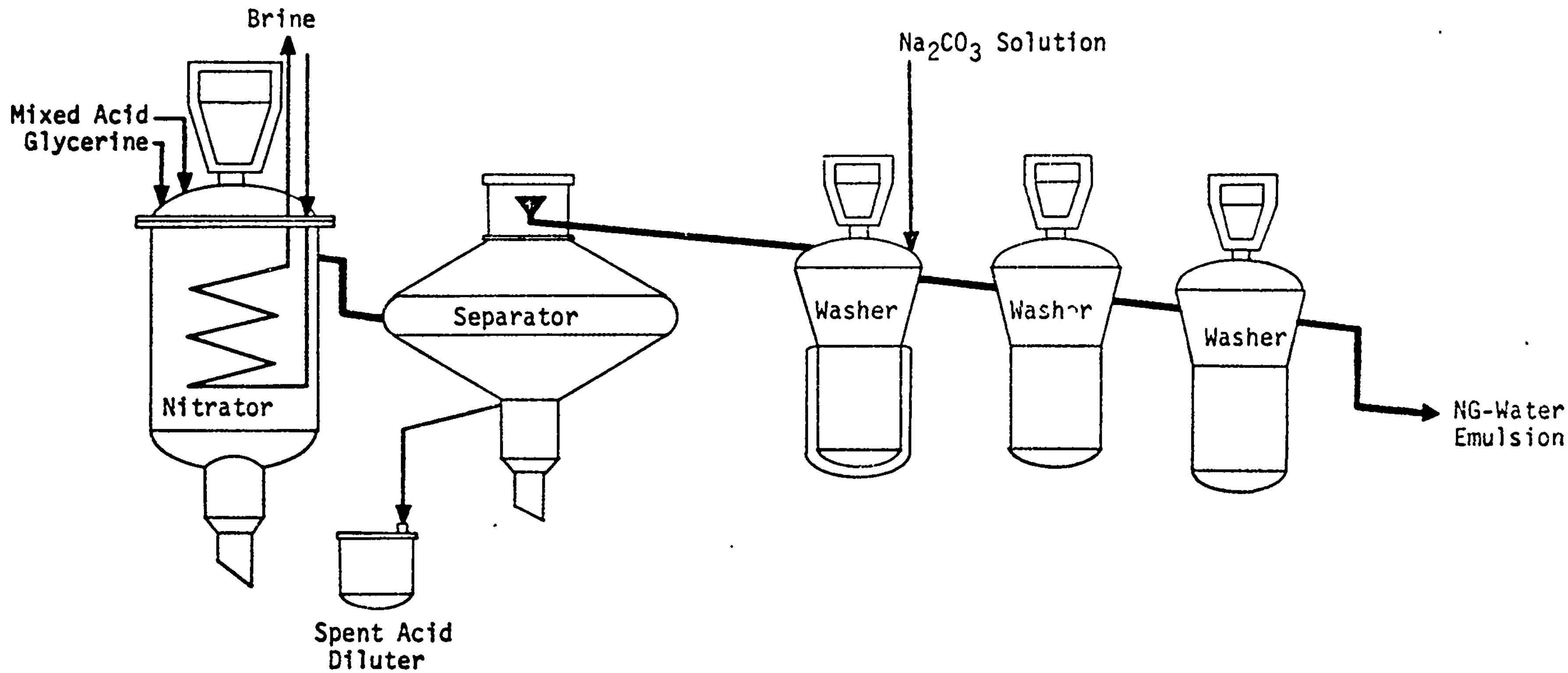
	Biazzi	Hanspeter Moser	Nitro Nobel
5. Control of Reaction Temperature	3-way valve on brine line.	Control valve on brine line.	Controlling glycerin flow.
C. Separator			
1. Separator Type	Semi-Static Separator	Static Separator	Centrifugal Separator DeLaval NGB-209-17B
2. Maximum Diameter	60 Inches	60 Inches	18 Inches
3. Capacity	210 Gallons	100 Gallons	800 Gallons
4. NG Retention Time	8 Minutes	4 Minutes	1 Minute
5. Acid Retention Time	50 Minutes	30 Minutes	30 Minutes
6. Total Amount of NG	170 Pounds	100 Pounds	50 Pounds
7. Amount of Free NG	40 Pounds	45 Pounds	10 Pounds
8. Drowning Time	12 Seconds	5 Seconds	6 Minutes
9. Power Requirement	None	None	4 hp
10. Separator Peripheral Speed	~ 20 rpm	~ 30 rpm	3,200 rpm
11. Separation Control	Interface control by controlling spent acid leaving.	Interface control by controlling spent acid leaving.	By controlling flow input to ejector that jets NG to next step.
D. Spent Acid Diluter	30 gal stirred cooled vessel where water is added.	40 gal stirred cooled vessel where water is added.	None Adaptable for water addition.
E. Washing and Neutralizing			
1. Washing Method	Countercurrent flow of emulsified NG through 3 mechanical stirred vessels of soda water.	Flow through an up and down column of soda water, separated, then through another column of water washing and finally separated.	Flow through a 16 gal degassing vessel up through 2 soda wash columns into a separator to remove soda water.

	Biazzi	Hanspeter Moser	Nitro Nobel
2. Diameter	20 Inches	12 Inches	8 Inches
3. Total Capacity	80 Gallons	140 Gallons	50 Gallons
4. Number of Washes	3	4	2
5. Total Retention Time	9 Minutes	3 Minutes	6 Minutes
6. Stirring RPM	600 rpm	~ 300 rpm	None
7. Power Required	2 hp/washer	4 hp	None
8. Total Amount of NG Present	100 Pounds	100 Pounds	300 Pounds
9. Soda Water Concentration	12%	10%	8%
10. Control	pH meter in last washer.	pH meter in first and last washer.	pH meter in degassing vessel.
11. Cooling Area	9 ft^2 in first washer.	None	None
12. Emulsion Separators Capacity	None	Two Static Separators 100 gal Total Capacity	One 24" Centrifuge Separator, 2 hp, 1,000 rpm, 30 gal Capacity

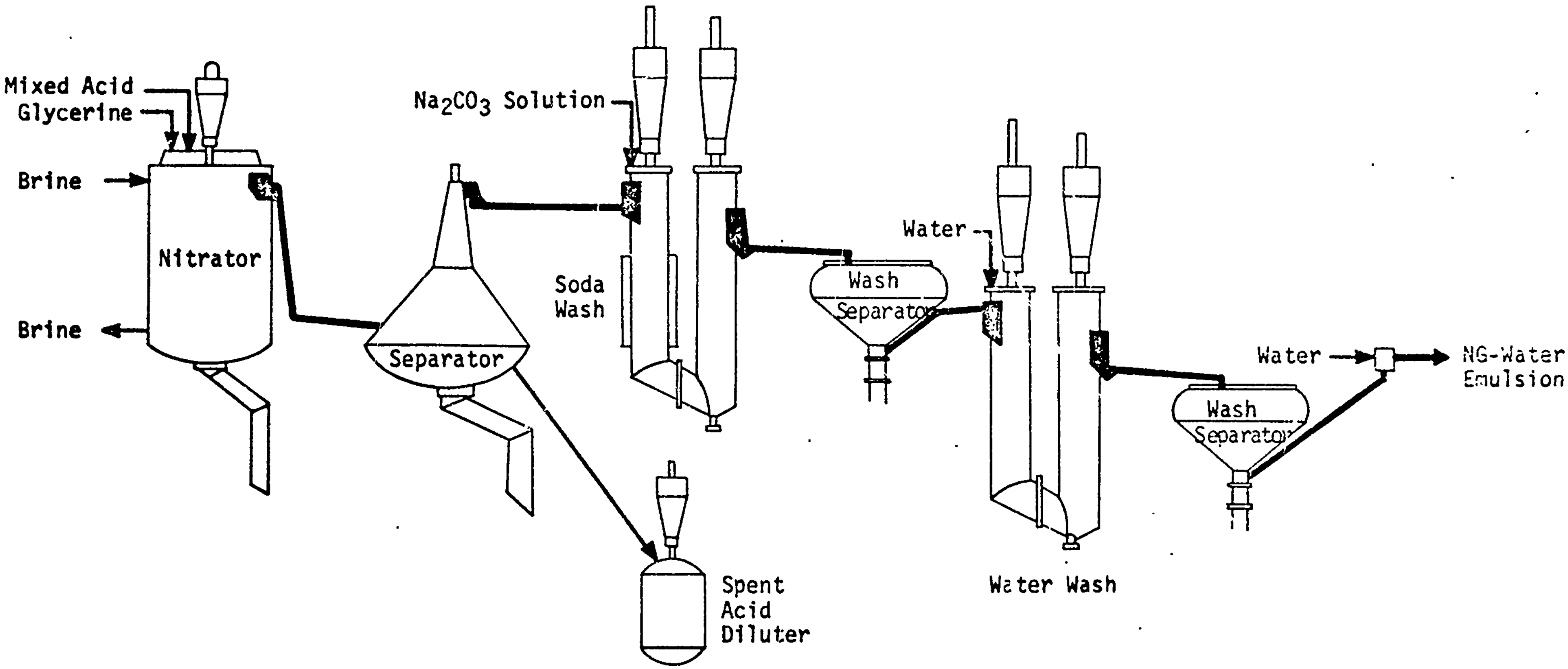
F. Utility Requirements

	Biazzi	Hanspeter Moser	Nitro Nobel
1. Electrical (hp)	4	4	7
2. Compressed Air (cfm)	40	80	20
3. Air Pressure (psi)	60	50	90
4. Refrigeration (tons)	33	31	36
5. Process Water (gpm)	7	13	8
6. Process Steam	None	None	None

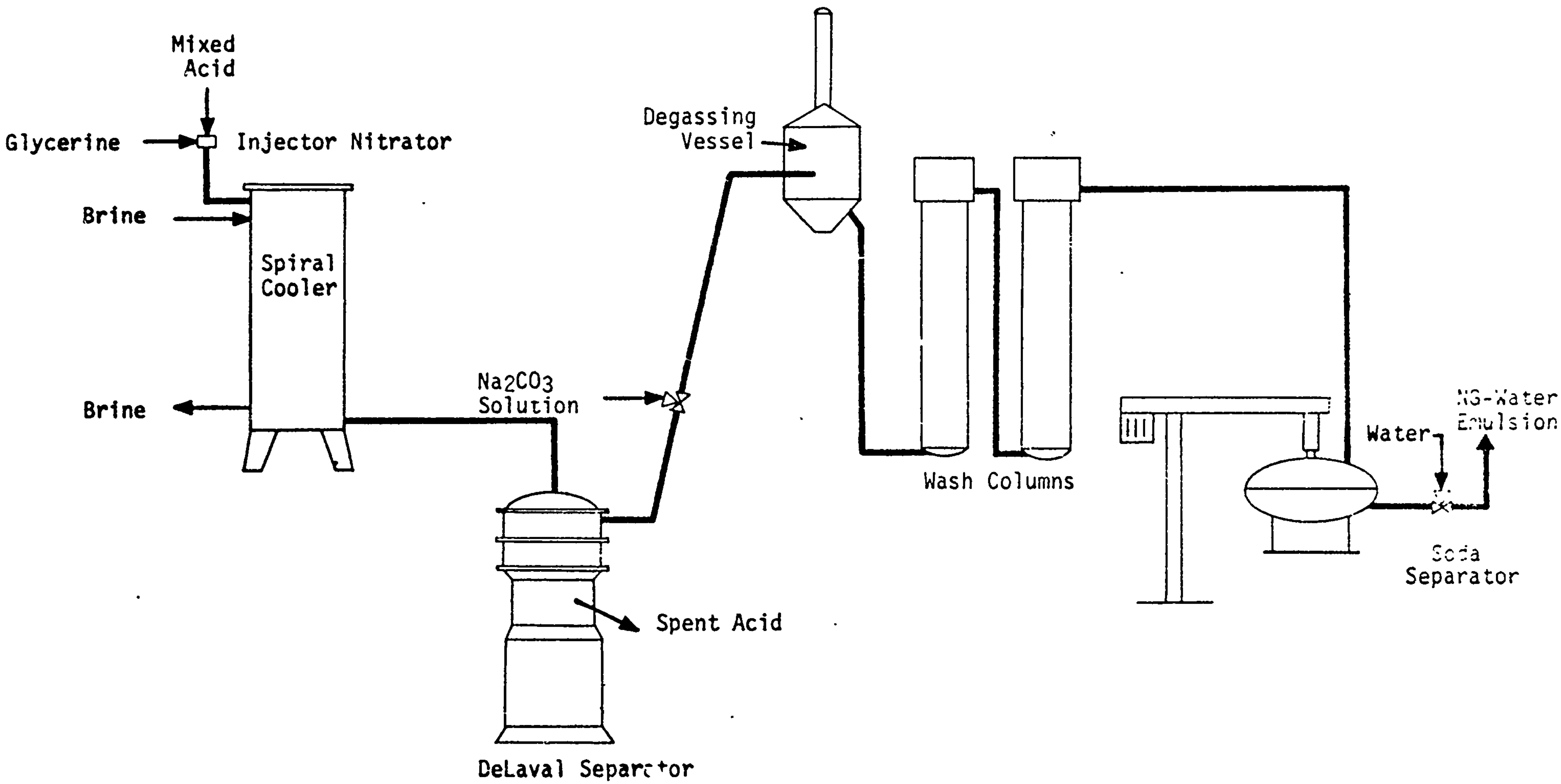
	Biazzi	Hanspeter Moser	Nitro Nobel
G. Raw Material Requirements (per 100 lb of product)			
1. Glycerin (lb)	42.8	42.8	42.8
2. Mixed Acid [50-50] (lb)	208	208	208
3. Soda Ash	7	8.5	8.5
4. Semi Concentrated Mixed Acid (lb)	360	360	360
5. Spent Acid Byproduct (lb)	145	145	145



BIAZZI FLOW DIAGRAM



HANSPETER MOSER FLOW DIAGRAM



NITRO-NOBEL FLOW DIAGRAM

BADGER ARMY AMMUNITION PLANT

OLIN CORPORATION

ENERGY SYSTEMS DIVISION

BARABOO, WISCONSIN

CONTINUOUS NITROGLYCERIN NITRATOR DESIGN EVALUATION USING A WEIGHED NUMERICAL METHOD

21 JULY 1970

CONTINUOUS NITROGLYCERIN NITRATOR DESIGN EVALUATION USING A WEIGHED NUMERICAL METHOD

Method Description:

Each area of design comparison was considered from a standpoint of overall importance and given a weighed point value. The nitrator vendors were assigned a rank for each area of design comparison. A rank of 3 for the best design and a rank of 1 for the least desirable. Points were accumulated by multiplying the rank by the weighed point value for each area of design comparison. (Example: The nitrator type for Biazzi was assigned a rank of 2, times the weighed points of 20, equals an accumulation of 40 points.)

Discussion of Evaluation:

A. Nitrator

The capacity of the nitrator is considered very important. A smaller size means less nitroglycerin in process and lower retention time. Low reaction temperature and good cooling is also preferred. The time required to drown or empty the nitrator in case of a hazardous condition is also important.

B. Control of Nitrator

Considering methods of mixed acid feed, a control valve and flowmeter is preferred over a volumetric pump. The injector drawing glycerin to the nitrator only when mixed acid is fed is superior to other feed methods. The control valve is considered to have the more positive control of feed. Control of reaction temperature is best effected by control of the cooling media flow rate.

C. Separator

The type of separator is very important. A separator should not have any moving parts, be of small capacity with low retention periods. The total nitroglycerin content must be minimized, but more important, the amount of free nitroglycerin should be eliminated, if possible. Drowning time should be as quick as possible. Control of separation through control of spent acid exit flow is preferred.

D. Spent Acid Diluter

A large, stirred, cooled vessel is required.

E. Washing and Neutralizing

Countercurrent flow of emulsified nitroglycerin through soda water and then water is the preferred washing method. Several fast, low capacity washes are preferred over one large volume wash. Retention time and flow rates should be as low as possible. Minimum amounts of nitroglycerin are mandatory. Final wash pH control is required as well as nitroglycerin separation with the requirements listed above.

F. Utility Requirements

Minimum requirements are preferred.

G. Raw Material Requirements

Minimum requirements are preferred.

H. Calculation Summary

	Comparison	Weighed Points	Accumulated Points Biazzi	Accumulated Points Hanspeter Moser	Accumulated Points Nitro Nobel
A.	Nitrator	200	335	445	450
B.	Control of Nitrator	100	220	200	260
C.	Separator	200	410	490	390
D.	Spent Acid Diluter	50	100	150	50
E.	Washing & Neutralizing	200	370	530	385
F.	Utility Requirements	100	230	220	180
G.	Raw Material Requirements	150	450	420	420
	TOTALS	1,000	2,115	2,455	2,135

I. Conclusion

The Hanspeter Moser Continuous Nitrator Design is preferred based on the above evaluation.

SUPPLEMENTARY

INFORMATION

DEPARTMENT OF THE ARMY Mr. Fordham/rc/AUTOVON 825-3200
BADGER ARMY AMMUNITION PLANT
BARABOO, WISCONSIN 53913

AD-A950 784

SMCBA-CR 21 March 1985

SUBJECT: Distribution of Badger AAP Document

Defense Technical Information Center
Defense Logistics Agency
Cameron Station
Alexandria, VA 22304-6145

1. Badger Army Ammunition Plant had a report done by its operating contractor, Olin Corporation, entitled "Design Comparison of Continuous Nitrators" dated 21 July 1970.

2. This report is a comparative evaluation of commercial processes and was never approved by Badger AAP for public release. A copy has come into our hands with your stamp on it, "DTIC Selected July 24, 1981", "AD-A950784", and "Approved for Public Release, Distribution Unlimited".

3. This report was never adopted nor its recommendation followed. This report was never intended for publication nor was it distributed outside of the U. S. Army Munitions Command and Omaha District Corps of Engineers. We did not submit it to your agency.

4. While we would still not consider this report releasable, it is obviously too late to stop public disclosure. In fact, the report has been used in advertising brochures to imply Army endorsement of their product.

5. We request that the following statement be added to your file copy, so that it will appear on any future releases of the report:

> "The opinions and/or findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation".

6. If possible, we would also like to know what agency or person released our report to your agency for unlimited distribution.

David C. Fordham

DAVID C. FORDHAM
Commander's Representative