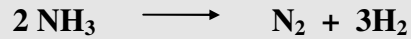


C.I. HAYES

AMMONIA DISSOCIATORS

The C. I. Hayes Ammonia Dissociators are designed for producing an economical source of pure, dry, highly reducing atmosphere. The product gas of hydrogen-nitrogen is produced by dissociation of anhydrous ammonia vapor.



Dissociated ammonia provides an excellent and economical atmosphere for a variety of applications that include *BRIGHT ANNEALING* of stainless steel, copper, brass, beryllium copper, nickel, nickel alloys and silicon iron to name a few. Other applications include *BRIGHT HARDENING* of tool and martensitic stainless steels, *BRAZING* and powder metal *SINTERING*.

I. CAPACITIES AND PRODUCT PURITY:

The capacities of the Hayes Series ADG Ammonia Dissociators range from 150 scfh to 5000 scfh at an outlet line pressure of 5 - 15 psig. Intermediate size units include 500, 1000, 1500, 2000, 3000 and 4000 scfh units. The resulting dissociated product gas is comprised of 75% hydrogen and 25% nitrogen. When utilizing a standard high quality "metallurgical grade" of ammonia vapor as the influent gas, a dissociated product of 99.97% purity, or less than 250 ppm of residual ammonia, will be maintained. The moisture content of the product will be less than 40 ppm, or a dew point of -50°F.

II. METHOD OF OPERATION:

Liquid ammonia contained within a storage tank is vaporized by either natural or mechanical means, and the resulting vapor is piped under pressure to the inlet of the dissociator. At this point, the high pressure vapor is reduced to the desired pressure. The vapor is then allowed to pass through a heat exchanger where it is preheated prior to entering the retort. The retort consists of an alloy cylinder containing the required catalyst to enhance the process of dissociation. The retort or "cracking" chamber is maintained at a constant 1750°F.

Although partial dissociation is possible at temperatures as low as 600°F, the rate of decomposition increases with temperature. 1750°F is selected to assure maximum equipment life with a minimum of residual ammonia carry over.

When subjected to temperature in the presence of high purity nickel and iron, the ammonia vapor (NH₃) dissociates, with the resulting gas being 75% hydrogen and 25% nitrogen. The product then exits from the retort and enters a heat exchanger where its heat is liberated to the incoming cold ammonia vapors. Monitoring of gas is through a flow meter located in the inlet line. The flow meter indicates flow of ammonia vapors and would, therefore, be one-half of the output flow.

C.I. HAYES

III. CONSTRUCTION:

1.0 HEATING CHAMBER:

The heating chamber will be insulated with three (3) courses of high quality graded insulation material and refractory. The material will be built up in staggered layers totaling 8 1/2" in thickness. This type of construction assures maximum thermal efficiency with a minimum amount of heat being liberated in the surrounding area.

2.0 HEATING ELEMENTS:

The heating elements will be of the silicon carbide or ceramic type conservatively rated, thus insuring maximum life. The elements are mounted transversely throughout the height of the chamber. Element installation or removal is accomplished within minutes by simply withdrawing the element through their respective supporting holes. This allows removal of the elements without disturbing the furnace insulation.

3.0 RETORT AND CATALYST:

The dissociating retort is a multi-pass, vertical loop, tube type, constructed of Inconel, and filled with catalyst. The retort is designed to prevent the slumping of the catalyst and minimize pressures on the side walls. The catalyst is usually considered an integral part of the retort, although some circumstances permit refilling the retort and replacing in service.

Both the inlet and outlet legs of the retort will be equipped with unions to facilitate ease of removal, should it ever be deemed necessary.

4.0 HEATING CHAMBER CASE:

The heating chamber case will be constructed of 10 gauge steel reinforced with steel structural members. The top of the chamber will be equipped with a removable cover for ease of access to the retort.

5.0 CONTROLS:

All controls are piped, mounted and wired to the right side of the dissociator.

C.I. HAYES

6.0 UNIT ASSEMBLY:

Dissociator is completely piped and wired, with all components mounted on a single frame. This construction requires customer to connect ammonia vapor to inlet, dissociated ammonia outlet to process line, vent outlets to vent line and power to terminals provided. All other connections are supplied and made. (Except for auxiliary power transformer when required.)

7.0 SPARE PARTS:

Parts are available from the factory, usually from stock, for immediate shipment. If the facility is vital to production it is recommended that the customer should maintain a spare parts inventory of the following items:

1. Heating Elements
2. Thermocouples
3. Retort

8.0 SERVICE (Optional):

After connections are made by the customer, as provided above, a Hayes Service Engineer is available to visit the installation, check out the connections and start up equipment; hence, this visit is called "Start-up Service". While at the installation, the Engineer would instruct customer's personnel in the care and maintenance of the equipment.

IV. GENERAL

1.0 DESIGN IMPROVEMENTS

Design changes and modifications may be incorporated at the final engineering stages to produce the best equipment possible.

2.0 FINISH:

The furnace will be completely finished and painted with C. I. Hayes Safety Blue to provide a pleasant appearance. All materials supplied will be of finest quality and assembled with fine craftsmanship synonymous with the Hayes tradition since 1905.

C.I. HAYES

3.0 MANUALS, PARTS LIST, DRAWINGS

Two (2) copies of maintenance and operational manuals with a recommended spare parts list and auxiliary equipment manuals/specifications are included. Drawings shall include (where applicable) an “Overall” floor-plan drawing; electric wiring and logic schematics; pneumatic and hydraulic schematics; water piping; atmosphere piping and “bills of materials”.

4.0 POST INSTALLATION “CHECK-OUT” and TRAINING

A trained C. I. Hayes technician is available for post installation “check-out” and instruction of operating / maintenance personnel at \$800.00 per day. Airfare, reasonable cost of living and travel expenses are separately invoiced at cost for start-up services.

5.0 CUSTOMER SATISFACTION

Every C. I. Hayes is manufactured and shipped with the expectation of 100% customer satisfaction. When installed at the users facility we guarantee that the quoted dissociator shall meet or exceed the following:

- Maximum Operating Temperature of 1800°F
- Maximum DA output as listed in the model number (CFH)
- DA will contain less than 250 PPM* of residual NH₃

Note: Requirements for acceptance, in addition to the above, will be quoted upon request.

* For these results, the customer must use Metallurgical (Premium) Grade Ammonia which is 99.995% pure.

C.I. HAYES

ECONOMICS OF OPERATION **

Anhydrous ammonia liquid at 70°F and 30" Hg yields 22.5 cu. ft. of gas/lb. of liquid. When passed through the retort, this vapor then is dissociated and doubles in volume, yielding 45 cu. ft. of dissociated ammonia gas.

Anhydrous ammonia may be purchased in 100# cylinders at \$.90/lb.

Anhydrous ammonia may be purchased in 4000# bulk at \$.50/lb.

Anhydrous ammonia may be purchased in 25000# transport at \$.28/lb.

Hence, dissociated ammonia cost based on bulk storage at \$.50/lb. used in a 1000 scfh ammonia dissociator requiring an installed power of 25 kW (averaging 22.5 kWh) equals:

$$\frac{1000}{45} \times \$0.50 \text{ plus } 22.5 \times 7.8 \text{ cents/kWh} = \$12.87/1000 \text{ scfh.}$$

Cost based on transport storage at \$.28/lb.:

$$\frac{1000}{45} \times \$0.28 \text{ plus } 22.5 \times 7.8 \text{ cents/kWh} = \$7.98/1000 \text{ scfh.}$$

For 100 pound cylinder usage, a manifold of 10 to 20 cylinders is required.
Usual withdrawal rate from a cylinder is 30 to 50 scfh.

For bulk storage, a 500 or 1000 gallon tank is required.

A 500 gallon tank measures 3' in diameter x 10' long.

For transport storage, an 8000 gallon tank is required.

An 8000 gallon tank measures 7' in diameter x 30' long.

** Note: All prices are approximate and are included to establish a model.
Please check with your local supplier to establish pricing for your area.

C.I. HAYES

AMMONIA DISSOCIATOR SPECIFICATIONS

<u>SIZE</u>	<u>CFH</u>	<u>KW</u>	<u>Volts</u>	<u>Ph</u>	<u>H</u>	<u>W</u>	<u>D</u>	<u>WT</u>	<u>DRYER*</u>
ADG-150	150	7.5	230	1	55"	27"	19"	500 lbs	MS-6
ADG-500	500	13.5	230	3	72"	38"	42"	2300 lbs	MS-11
ADG-1000	1000	28	230	3	73"	49"	45"	3500 lbs	MS-30
ADG-1500	1500	32	230	3	76"	46"	62"	3900 lbs	MS-30
ADG-2000	2000	48	230	3	76"	56"	63"	4150 lbs	MS-60
ADG-3000	3000	64	230	3	80"	70"	57"	4800 lbs	MS-60
ADG-4000	4000	84	230	3	82"	79"	67"	6100 lbs	MS-90
ADG-5000	5000	140	230	3	98"	79"	77"	8200 lbs	MS-120
ADG-6000	6000	175	230	3	98"	79"	77"	8800 lbs	MS-120

* Dryers are sized to dry the dissociated ammonia to dew point range of -80°F. to -100°F. and to remove up to 250 ppm NH₃, leaving less than 10 ppm of residual NH₃.

Note: Input voltages other than 230 volts will be quoted upon request.

Note: To insure compliance with local codes the user is responsible for supplying:

- A regulated gas supply from an appropriate source.
- Incoming power from an appropriately sized, fused, wall disconnect switch.