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International Fertilizer Industry Association - Secretariat: 28 rue Marbeuf - 75008 Paris - France
Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

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PRODUCTION SYNERGY-FERTILIZERS AND CHEMICALS - GNFC EXPERIENCE[1]

G.K. Parikh, K.M. Jani and G.C. Shah
Gujarat Narmada Valley Fertilisers Company Ltd., India

SUMMARY

The aim of this paper is to share the concept of co-production utilizing CO-CO_2-H_2 streams for producing high value chemicals. The idea of multi product company is discussed which has held in countering the current commercial challenges faced by fertilizer industry. Advantage of gasification facility having CO rich streams for installing chemical plants is elaborated.

RESUME

Le but de cet exposé est de partager le concept de co-production utilisant les flux CO-CO_2-H_2 pour la production de produits chimiques à haute valeur. L'idée d'une société multi produits est examinée. Elle a permis de faire face aux défis rencontrés par l'industrie des engrais. L'avantage d'une unité de gazéification ayant des flux riches en CO pour installer des unités chimiques est analysé.

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INTRODUCTION

Gujarat Narmada Valley Fertilisers Co. Ltd. (GNFC) is one of the world's largest single stream fuel oil based ammonia and urea complex located in India's fast growing industrial zone at Bharuch in Gujarat. Capacity of ammonia and urea plants is 1350 MTPD and 1800 MTPD respectively. Production of ammonia based on fuel oil as feed stock was selected mainly because of surplus fuel oil availability from nearby refinery. High pressure partial oxidation process of M/s. Texaco of USA was selected for Ammonia plant. Due to long process route by partial oxidation of fuel oil there were different problems during initial phases, but subsequently these bottlenecks were overcome by meticulous planning and production figures were improved.

Capacity utilisation of ammonia plant was improved to a great extent and this lead us to think in the direction of installing a huge phosphatic fertilisers complex based on surplus ammonia.

Alternatively, all possible chemicals like methanol, formic acid, weak nitric acid, methyl formate, acetic acid, aniline & TDI plants were installed on CO+H_2 streams obtainable from the ammonia plant. This complex exhibits a rare integration of so many plants put together with the ammonia plant.

GNFC has also diversified into electronics field for production of PCB, RAX and PAX. Commissioning details of all plants are tabulated in Table 1.

[1] *Synergie de production - engrais et produits chimiques - expérience de GNFC*

Table 1

PLANTS	CAPACITY/ANNUM	COMMISSIONED ON
AMMONIA	4,45,500 MTS	06/12/81
UREA	5,94,000 MTS	13/12/81
METHANOL-1	10,000 MTS	07/08/85
FORMIC ACID	5,000 MTS	11/04/89
METHANOL-2	100,000 MTS	04/01/91
WNA	207,900 MTS	25/03/90
CNA	33,000 MTS	02/10/90
ANP	1,42,500 MTS	12/09/90
CAN	142,500 MTS	01/08/90
ANILINE	10,000 MTS	31/12/94
ACETIC ACID	50,000 MTS	12/09/95
POWER PLANT I	25 MW	22/03/87
POWER PLANT II	25 MW	25/03/89
TDI	10,000 MTS	UNDER COMMISSIONING
PCB	44,000 SQ.MTR	MARCH - 1989
PAX-RAX	20,000 LINESACH	OCT - 1987

CONCEPT-CHEMICALS WITH FERTILISERS

Texaco's partial oxidation process for producing ammonia based on fuel oil poses different operating problems compared to conventional steam reforming plants. Handling of soot which gets carried over to down stream sections creates various problems in CO shift and Rectisol wash units. Presence of high concentration of H_2S and other impurities in oil like Ni, Va leads to scheduled downtime of gasifiers for inspection of refractories and quench ring. In GNFC all the possible built in capacities were utilized to increase the plant load and compensate for downtimes which were mandatory for inspection of equipments. Capacity utilization was thus increased to as high as 117% from 85% with meticulous planning of shutdown and in depth study of process parameters.

Production of ammonia is covered under Government subsidy which is being continuously reduced. Governments bill for subsidy is increasing because of more production and increased consumption of fertilisers. The pricing policies have made fertilizers companies to think of alternative methods for survival, since producing fertilizers would not be profitable business. For removal of CO_2 from raw gas low temperature Rectisol wash unit utilizing methanol as absorbing media is used. We had installed a small plant to produce methanol from raw gas in 1985 because methanol was captively used for rectisol wash unit. We entered into the market of methanol sale and subsequently installed 300 MTPD plant based on natural gas. Other plants namely formic acid, acetic acid, WNA, CNA helped us to counter the situation of profits in view of inconsistent and unpredictable fertilizer subsidy situation.

The production network of various chemicals is shown in Figure I. Details of all gas streams for the feed of various products are explained in Table 2.

FERTILISERS WITH CHEMICALS
PRODUCTION NET WORK

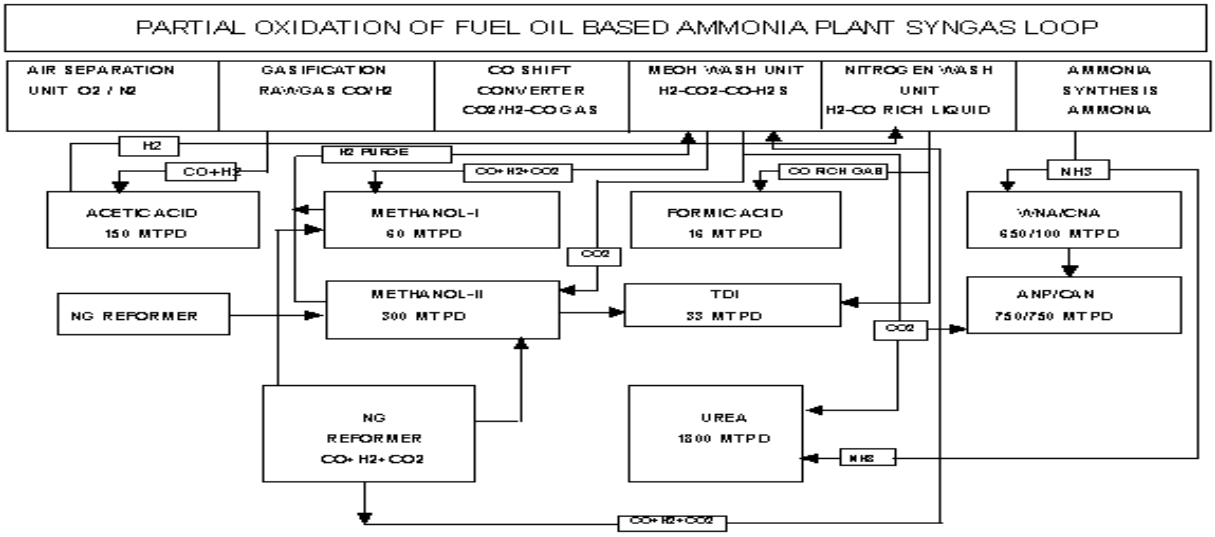


FIG-I

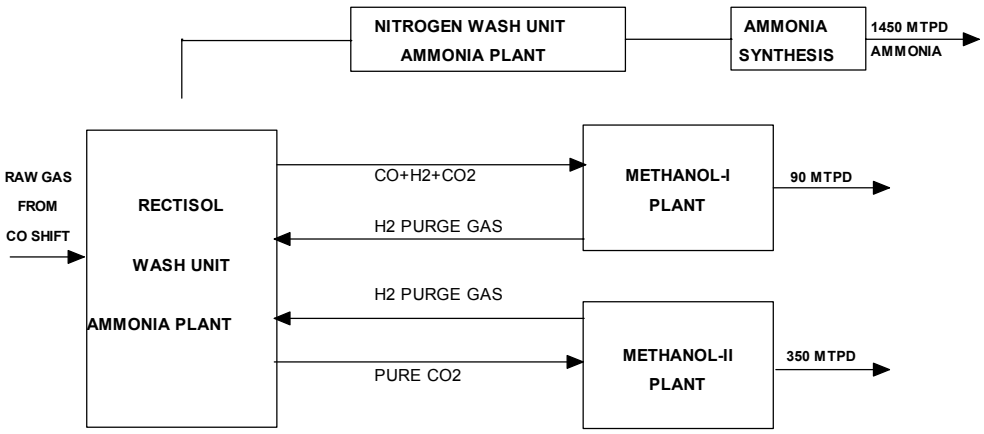
Table 2—Details of Various Streams

STREAM	CO %	H2 %	CO2 %	N2 %	FEED FOR PRODUCT	PRESSURE BAR	TEMP °C	FLOW NM3/HR
GASIFIER OUT	47.7	43	6.94	0.11	ACETIC ACID	78	255	126,798
WASH OUT	1.86	75	22	0.13	MEOH-I	71.6	10	8,420
TAIL GAS	41.5	4.6	-	33.2	FORMIC ACID	1.77	5	6,526
TAIL GAS	41.5	4.6	-	33.2	TDI	1.77	5	6,526
TAIL GAS	41.5	4.6	-	33.2	BOILER	1.77	5	6,526
CO2 GAS	0.07	0.49	85.4	14.4	ANP	1.05	5	3,000
CO2 GAS	0.08	0.91	98.8	0.09	MEOH-II	1.55	-15	1,500
NH3 LIQUID	-	-	-	-	WNA	15	10	300 MTPD

CO PRODUCTION - AMMONIA AND METHANOL

Since inception of our project, Methanol plant of 60 MTPD was designed for captive consumption as well as for sale. This plant we commissioned in '85 with the feed gas from Rectisol wash unit and ICI technology. The production levels were increased to 150% of design capacity.

Initially methanol market in India remained small but gradually methanol based chemicals like formaldehyde and MTBE increased the market of methanol. This trend continues and based on that we installed a 300 MTPD gas based methanol plant. The production levels were enhanced by injecting CO_2 which was available from ammonia plant. This indicates the level of integration and giving priority to manufacturing a product having higher value addition. In the above case CO_2 available for urea was diverted for manufacture of more value added methanol. Figure II describes the integration of ammonia plant with methanol plants.

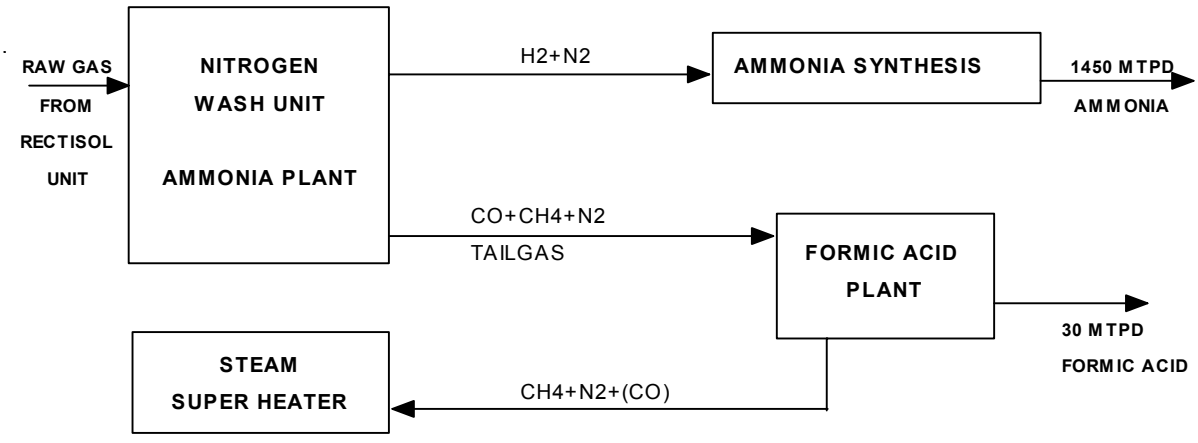


CO PRODUCTION AMMONIA - METHANOL

FIG-II

FORMIC ACID - EFFECTIVE UTILISATION OF WASTE STREAM

Nitrogen wash unit in the ammonia plant which is meant for removal CO and CH_4 from raw gas generates a waste stream containing about 45% CO. This stream is utilised as a fuel in one of the steam superheaters in the ammonia plant. Formic acid was totally imported to cater the Indian market. In order to profitably utilised the CO rich stream from ammonia plant the idea was initiated to produce formic acid. M/s Kemira of Finland supplied us the technology for the production of 5000 TPA of formic acid via methyl formate route. The market of formic acid improved considerably which forced us to increase our production to cover the entire Indian market. By various modifications and changing the process parameters yearly production was improved to 9000 TPA. We have also seen the market of methyl formate separately. We have been exporting both methyl formate and formic acid to various countries since the purity of the products are of the international standards. Figure III describes the integration of formic acid plant with ammonia plant.

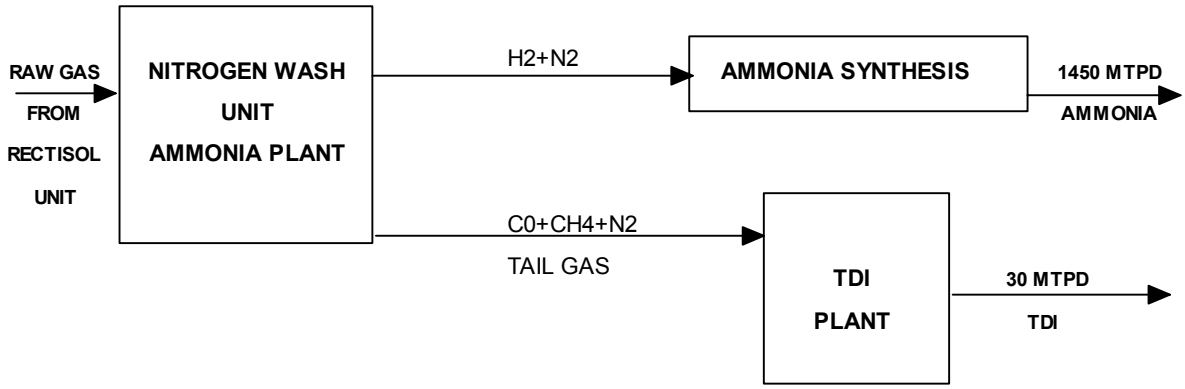


FORMIC ACID - BEST OUT OF WASTE

FIG-III

TOLUENE DI ISOCYNATE - A MONOPOLY PRODUCT

Toluene diisocynate is being continuously imported in India. TDI market is increasing the increase in automobile industry. Maintaining our trend of installing plants based on CO rich streams We decided to install a 10,000 TPA TDI plant based on Du Pont technology. The CO rich stream available from nitrogen wash unit of ammonia plant is utilised for the production of TDI. Aniline produced for the TDI manufacturing is also having good market potential in the Indian market. The plant has been successfully commissioned recently. This high value product counters the subsidy issue of fertilizers. Figure IV describes the integration of TDI plant with the ammonia plant.



TDI A MONOPOLY PRODUCT

FIG-IV

MULTI PRODUCT OUTPUT - WNA/CNA/PHOSPHATIC FERTILISERS

As described earlier in this paper ammonia plant capacity utilisation was increased to 117% which gave us a surplus of 250 MTS of ammonia on daily basis. Based on our concept of multi product company, it was decided to produce phosphatic fertilisers. Investment to the tune of @ Rs 3000 million was planned for this project. The capacities of weak nitric acid, conc. nitric acid, calcium ammonium nitrate and ammonium nitrophosphate is as shown below:

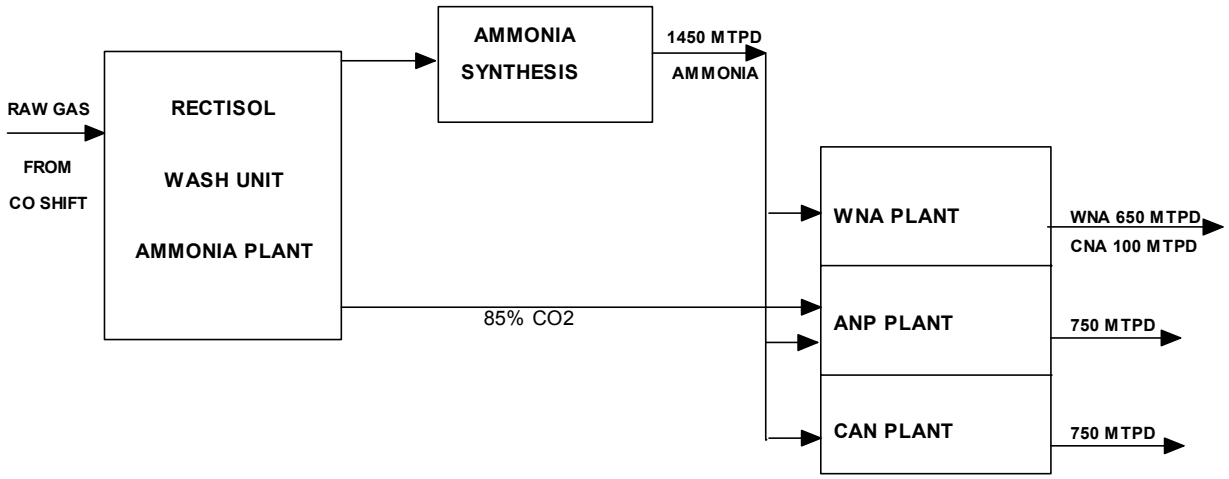
PRODUCT	CAPACITY MTPD
WNA	660
CNA	100
ANP	750
CAN	750

Apart from surplus ammonia which is used for manufacturing above,an impure CO_2 stream generated in Rectisol wash unit of ammonia plant is utilized as CO_2 source in NP manufacturing. This aspect again highlights the integration of other plants based on the streams from ammonia plant.

There is a huge market for weak nitric acid in the surrounding industries. Additionally conc. nitric acid is used in the manufacturing of TDI. We generate ammonium nitrate melt which also has a very good market.

Looking to these multi products, the production levels of these products are decided based on profitability of an individual product and prioritising the production depending on the prevailing market conditions.

With the rapid expansions of various projects in our company, utmost care is taken on the environmental aspects. Our company strives for maintaining the situation of zero effluent discharge in spite of installation of above mentioned facilities. Figure V shows the details of various connections with ammonia plant.



MULTI PRODUCT OUTPUT

FIG - V

ACETIC ACID - ADVANTAGE OF GASIFICATION TECHNOLOGY

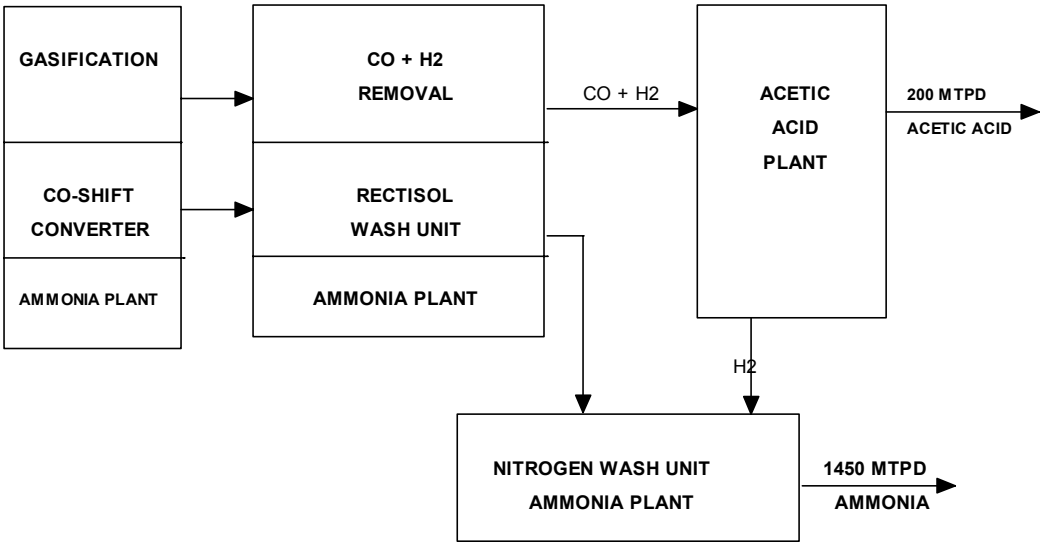
The total demand of acetic acid in India was catered through small manufacturers of acetic acid which is being manufactured from molasses. Balance quantity was fed through imports. Molasses market is dependent on the crop of sugar cane and hence it is sometime unpredictable. The prices of molasses are also governed in a complex manner which makes the acetic acid market quite fluctuating. The entire world market of acetic acid is generally governed by BP Chemicals, UK since they have large manufacturing facilities for acetic acid and also they are the licenser of the technology for producing acetic acid through methanol carbonylation route.

We had been trying for the license of this technology since we had methanol and carbon monoxide available at site to manufacture acetic acid through methanol carbonylation route which was first time in India. Looking to the market of acetic acid in India and availability of surplus methanol, a 50,000 TPA plant was installed in 1995. The raw gas exit of gasifier containing 45% CO was utilised for producing 98.5% pure CO through cryogenic route which is used for reaction with methanol to produce acetic acid. Exotic material of construction forms an important feature and majority cost component of acetic acid plant.

This plant produces high purity acetic acid which is useful for VAM and PTA manufacture. Acetic acid exhibits a superb integration of utilising existing chemicals produced along with gas streams of ammonia plant. As the market of acetic acid is fast growing our planning of expansion is on cards. The details are shown Figure VI.

COST EFFECTIVENESS - PRODUCT VIABILITY

Our project was initially proposed for production of ammonia and urea during 1978. Subsequently other plants were added making a synergetic approach. The downstream plants like formic acid, TDI and acetic acid if stood alone plants would have costed a company huge investment for making raw material availability to these plants. The present small capacities of these plants which is sufficient for Indian market consumption would also not have been justified. Since raw material and infra structure availability was ensured in advanced these projects proved viable and a very good alternate to fertilizers.



ACETIC ACID - A MONOPOLY PRODUCT

FIG - VI

CONCLUSION

In summary, a gasification facility brings many synergistic benefits such as:

- Production of various widely used chemicals.

- Utilisation of waste streams for producing value added chemicals.

- With multi product concept facility to produce chemicals as per market demands.

The current commercial challenges facing the fertiliser industry today is eased with the help of diversification into different products. In order to sustain the production levels reliability of gas availability to different plants is of prime importance. We are planning to add one more gasifier into the existing system for ensuring that uninterrupted gas supply is available to downstream plants.