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Reduction of Ream Packing Machine Engineering Downtime by 50% from Current Level.

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A B S T R A C T

Ream packing machine engineering downtime is one of the major problem in finishing house .Due to this internal customer do not get the desired quantity as per the order quantity. And also we unable to run the sheeters due to floor jamming .This leads to internal customer dissatisfaction. This project is aimed to reduce the overall engineering downtime of ream packing machine by 50% from current level

Introduction

The efficiency in operation of ammonia and urea plants is determined by various factors like plant reliability, type of feedstock, availability of the utilities,
Labor relations, market conditions, etc. The most important of these factors is there liability of the plant and machinery. Maintenance and inspection are the two important functions which can ensure a high reliability and availability of the continuous process plants. The high on-stream factor and operating efficiency can only be achieved with the systematic inspection program me leading to predictive maintenance program me. It is needless to mention that high plant reliability also helps in ensuring environmentally safe operations.[1,10]

DMAIC Steps – Objective

Define : Define your business problem

- Measure : Measure your process (Y) performance:
  Find the root causes (X's) of the problem
- Analyze : : Find the root causes (X's) of the problem
- Improve: Improve, implement new solution
- Control: Deliver Y performance over time:

Method of Analysis

The detailed data obtained from these plants under various classifications was converted to the downtime in days per plant per year (DDPY).

DDPY = Number of days of downtime/ (Number of plants/number of years).

The trends in downtime due to various causes over the previous years are also presented.[1,5]

Ammonia Plants

Causes for Loss of Production **Table 1** shows the reasons for loss of production of ammonia and urea during the survey period. Of the total loss of production of 2.67 MMT of ammonia, 37.8%of loss was due to equipment problem. Shortage of inputs like natural gas, naphtha, fuel oil and coal accounted for 22.5% of loss of ammonia production. Miscellaneous factors included high inventory levels of products etc. Similar trends were observedin the causes for loss of production of urea during the survey period i.e. 2009-12

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Duration of Turnaround

Average duration of planned turnaround (maintenance) shutdown of 29ammonia plants was 19.1 days per plant per year (DDPY) compared to 22.5 DDPY during 20091202 and 18.4 DDPY during 2003-06. Due to slack in consumption of urea and built up of production capacity, GOI put a cap on allocation of urea to various Duration of Turnaround Average duration of planned turnaround (maintenance) shutdown of 29
ammonia plants was 19.1 days per plant per year (DDPY) compared to 22.5 DDPY during2006-09 and 18.4 DDPY during 1996-99. Due to slack in consumption of urea and built up of production capacity, GOI put a cap on allocation of urea to various Downtime in Ammonia and Urea Plants
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24.7.2006 Page 4 of 12units for sale under Essential Commodity Act (ECA) in the 2003-06. This forced the units to take longer shutdown mainly in March and the same were classified as planned turnaround for maintenance. This was reflected in increase in average duration of turnaround in 2011-12 period. The cap on production continued till the year 2003-04. However, two units, that is, FACT-Cochin and NLC-Naively whichwere not operating well, closed down. These two factors had opposite effect on the duration of downtime. However, most of the other units have shown continuous improvement in reducing the duration of turnaround

Number of Shutdown

There was significant reduction in number of forced shutdown at 6.5 shutdowns per plant per year (SPY) from 8.2 SPY during 2009-12- and 12.3 SPY during 2003-06

Causes of Downtime

Downtime in ammonia plants is segregated into groups under mechanical, electrical, instrumentation, process and miscellaneous failures. The total downtime in ammonia plants came down by more than 50% from 31.2 DDPY during2003-06 period to 14.8 DDPY in the 2006-09 period (**Table 2**). Maximum forced downtime(41.5%) was due to problems of non-availability of inputs, shortage of water and power etc. which are classified under miscellaneous reasons. These problems are usually beyond the control of plant management. Mechanical (equipment related)problems are the next important reason accounting for 39.6% of total forced downtime in ammonia plants. These problems are technical in nature and can be minimized with timely and appropriate action on the part of management. Therefore, the downtime due to mechanical failure was analyzed further[2,10]

Downtime due to Mechanical Failures

Section wise downtime data due to mechanical failures for 25 plants based on reforming process and 4 plants based on gasification process are shown in **Table 3 &Table 4** respectively. Reforming plants accumulated a total downtime of 433 days.

Primary reformer, synthesis gas compressor and air compressor were the major contributors to the downtime. RCF-Tomboy V, IFFCO-Pulpier I and II encountered the problem in primary reformer. BVFCL-Namur III, IFFCO-Kalol, RCF-Tomboy[5,7]
V and IFFCO-Phulpur II faced problems in snags compressor. KSFL-Shahjahanpurand FACT-Alwaye had problems in the air compressor. Other sections like secondary reformer and purification were also responsible for significant downtime. BVFCLNamrupIII reported a downtime of 10 days in refrigeration compressor during the period. Amongst other equipments, auxiliary boiler, piping and valves contributed a significant downtime of more than 25 days. In gasification plants, high downtime was contributed by synthesis compressor(38.9%) followed by air separation unit (20.7%) and purification (12.0%). It also reported a downtime of 8 days due to problems in exchangers of air separation unit. At GNFC snags compressor caused a downtime of 17 days during the 3-year period under review
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Downtime in Urea Plants

Downtime data of 28 urea plants was analyzed for the period Downtime data of 28 urea plants was analyzed for the period of 2002-05. Production of urea being dependent on availability of ammonia and carbon dioxide from ammonia plant, the trend in downtime for urea plants are generally similar to ammonia plants. The downtime for planned turnaround shows that duration of
turnaround increased from 17.7 DDPY in 2003-06 to 25.2 DDPY in 2006-09 and came down to 21.4 DDPY for the present survey period of 2009-12. The explanation given for similar trend in case of ammonia plants is equally applicable here. The number of shutdown per plant per year (SPY) have come down over the years, but still remains high at 11.4.The average downtime (total) in urea plants has come down to 31.0 DDPY compared to 38.3 DDPY during and 39.8 DDPY in (**Table 5**).However, as in the case of ammonia plants, the largest share in downtime of urea plants was accounted for by miscellaneous reasons. The reasons included cap on production of urea due to limited allocation under ECA, shortage of feedstock ,utilities, water scarcity and all other reasons which affected production of ammonia. It is heartening to note that downtime due to mechanical failures has maintained downward trend for the last several years, registering a figure of 5.9
DDPY (**Table 5**) during the latest 3 years period. However, there is a scope for further improvement in this area. The details of downtime of major equipment items in urea plants are given in **Table 6**. Stripper, reactor, exchangers, piping and valves
remained the major items contributing to closure of plants. RCF-Thal, NFC LKakinadaI, CFCL-Gadepan II, IFFCO-Phulpur

I faced the problem in stripper.Reactor problems accounted for significant downtime at NFCL-Kakinada I, ZIL-Goaand KRIBHCO-Hazira. RCF-Thal and GNFC-Bharuch reported long downtime dueto problems in heat exchangers. BVFCL-Namrup III accounted for downtime of 127days of the total downtime of 477 days in all the urea plants during the period. In

fact, 4 urea units accounted for more than half of the total downtime in all urea plants

On-stream Efficiency

The on-stream days of a plant can be calculated by subtracting the period of shutdown whether forced or planned. For ammonia plants, average on-stream days of330 days for the survey period are higher than 311 days for the previous survey period of 2003-06Similarly, average on-stream days of urea plant at 310 days are higher than 301 days for the period of previous survey. The following three efficiency factors namely; operating factor, service factor and reliability factor were calculated to evaluate the performance of the plants

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a) Plant Operability factor indicates the actual operation of the plant during the year.

$$\text{Operating Factor} = \frac{365 - \text{total downtime in days} \times 100}{365}$$

b) Plant Availability or service factor signifies the actual availability of the plant for operation in absence of downtime due to reasons other than internal to the plant.

$$\text{Service Factor} = \frac{365 - \text{total downtime in days} \times 100}{365 - \text{business related downtime}}$$

c) Plant Reliability factor is an indicator of the reliable operation of a plant

$$\text{Reliability Factor} = \frac{365 - \text{total downtime in days} \times 100}{365 - \text{business related downtime \& duration of planned turnaround in days}}$$

Here, the business relating downtime is the forced downtime due to external factors such as shortage of feedstock, power and water problems, labor problems ,etc. The objective of calculating the above factors is to show the reliability of plants from technical point of view. These efficiency factors are summarized in **Table 7**.The table shows that the operation of ammonia plant took place 90% of the time while the plants were available for service 92% with 97% reliability during 2009-12 period.

The **figure 1** shows the operating factor of ammonia plants divided into 4qualities. It is obvious there is need to improve the operating factor of the quartile with operating factor of 83.9 % by way of reduction in duration of turnaround and forced downtime due to equipment problems

Table 1: Major Reasons for Loss of Production in Ammonia and Urea Plants for2009-12

Reasons	NH3 (‘000 MT)	%	Urea (‘000 MT	%
1. Equipment Breakdown	1011	37.8	1450	35.6
2. Power Problems	61	2.3	145	3.6
3. Shortage of Raw Materials	602	22.5	1322	32.4
4. Labour Problems	0.8	0.03	0.0	0.0
5. Water Problems	47	1.8	63	1.5
6. Miscellaneous	950	35.5	1094	26.8
Total Loss	**2672**	**100.0**	**4075**	**100.0**

Table 2: Downtime in Ammonia Plants for Various Survey Periods
(All the Plants)
(DDPY = Downtime in Days/Plant/Year

Reasons 1996-99	**(DDPY)**	**2003-06**	**(DDPY)**
1. Mechanical	14.7	14.7	5.9
2. Electrical	0.6	0.7	0.8
3. Instrumentation	1.1	1.0	1.4
4. Process	1.6	1.9	0.6
5. Miscellaneous	10.3	11.9	6.1
Total	**28.3**	**30.2**	**14.8**

Table 3: Downtime Due to Mechanical Failures in Ammonia Plants for2006-2009
(Based on Reforming Process

Major Sections	**(25 plants)**	**Downtime**
1. Pre-treatment Section	3.0	0.7
2. Pre-reformer	15.8	3.7
3. Primary reformer	72.4	16.7
4. Secondary reformer	48.4	11.2
5. Purification	45.3	10.5
6. Synloop & Refrigeration	21.2	4.9
7. Syngas Compressor	68.0	15.7
8. Other Compressors & Turbines	87.0	20.1
9.Miscellaneous Major Equipments	71.7	16.6
Total	**432.8**	**100.0**

Table 4 : Downtime Due to Mechanical Failures in Ammonia Plants for 2009-12(Based on Gasification Process)

Major Sections (4 Plants)	Downtime (Days)	Downtime %
1. Gasifier	1.0	1.7
2. Air Separation Unit	12.0	20.4
3. Purification	7.0	12.0
4. Synloop & Refrigeration	2.0	3.4
5. Syngas Compressor	23.0	38.9
6. Other Compressors & Turbines	2.0	23.4
7. Miscellaneous Major Equipments	12.0	20.3
Total	**59.0**	**100.0**

Table 5: Downtime in Urea Plants for Various Survey Periodsall the plants)(DDPY = Downtime in Days/Plant/year)

Reasons 1996-99	(DDPY)	2006-09	(DDPY)
1. Mechanical	10.5	6.3	5.9
2. Electrical	0.5	1.0	0.5
3. Instrumentation	0.6	0.5	0.5
4. Process	0.4	0.5	0.4
5. Miscellaneous	27.8	30.2	23.7
Total	**39.8**	**38.2**	**31.0**

Table 6: Details of Downtime due to Mechanical Failure in Urea Plants(DDPY = Downtime Days/Plant/Year)

Equipment Items	2003-06	2006-09	2009-12
1. Ammonia pre-heater	0.34	0.08	0.05
2. Ammonia Plants	0.77	0.12	0.05
3. Carbamate Pump	1.82	0.06	0.28
4. Slurry & Other Pumps	0.41	0.01	0.00
5. CO2 Compressor	1.73	1.10	0.39
6. Autoclave/Reactor	1.08	1.64	0.58
7. Let Down Valve	0.07	0.03	0.00
8. Heat Exchangers	0.45	0.50	0.51
9. Decomposer/Stripper	0.83	1.31	1.44
10. NH3/CO2 Recovery Column	0.03	0.02	0.02
11. Absorber/Recovery Vessels	0.56	0.07	0.21
12. Evaporator/Crystalliser	0.13	0.02	0.06
13. Centrifuge	0.05	0.03	0.00
14. Steam Ejector/Vacuum Generator	0.00	0.03	0.06
15. Dryer/Cooler	0.10	0.02	0.08
16. Blower/Fan	0.17	0.02	0.04
17. Conveyer/Elevator	0.60	0.06	0.02
18. Prill Tower	0.25	0.13	0.19
19. Piping/Valves	0.50	0.39	0.43
20. Miscellaneous	0.62	0.55	1.48
Total	**10.50**	**6.17**	**5.89**

Table 7 : Operating Service & Reliability Factors for Ammonia and Urea Plants2002-05

	Operating Factor	%	Service Factor
Ammonia	**90.3**	**90.3**	**97.1**
Urea	**85.0**	**85.0**	**97.9**

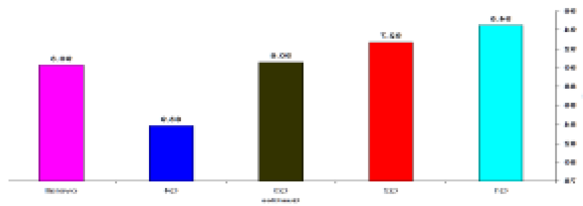

Fig1Quartiles for Operating Factors of Ammonia Plants during 2009-12

Conclusion

Performance of ammonia and urea plants has improved significantly during2002-05 period which is reflected in achievement of average on-stream days of 330for all ammonia plants. High speed rotating machines like syngas compressor and air compressor, and heat exchangers/waste heat boilers need attention to further improve their operational reliability. A few fertilizer units continue to have significant downtime due to other static equipments like urea reactor and reformer. These units have to strive hard to improve reliability of critical equipment in order to achieve high on-stream efficiency

Referance

1. Donald G. Fink and H. Wayne Beaty (August 25, 2006).*Standard Handbook for Electrical Engineers*. McGraw-Hill Professional. pp. 14–37 equation 14–56. ISBN 978-0-07-144146-9.
2. "The HVDC Transmission Québec–New England". ABB Asea Brown Boveri. Retrieved 2008-12-12.[dead link]
3. *The Corsican tapping: from design to commissioning tests of the third terminal of the Sardinia-Corsica-Italy HVDC*Billon, V.C.; Taisne, J.P.; Arcidiacono, V.; Mazzoldi, F.; Power Delivery, IEEE Transactions on Volume 4, Issue 1, Jan. 1989 Page(s):794–799
4. "ABB solves 100-year-old electrical puzzle – new technology to enable future DC grid". ABB. 2012-11-07. Retrieved 2012-11-11.
5. Callavik, Magnus; Blomberg, Anders; Häfner; Jacobson, Björn (November 2012), *The Hybrid HVDC Breaker: An innovation breakthrough enabling reliable HVDC grids*, ABB Grid Systems, retrieved 2012-11-18
6. Source works for a prominent UK engineering consultancy but has asked to remain anonymous and is a member of Claverton Energy Research Group
7. Spain to invest heavily in transmisson grid upgrades over next five years | CSP Today. Social.csptoday.com (2010-04-01). Retrieved on 2011-04-09.
8. Guide to the specification and design evaluation of AC filters for HVDC systems, CIGRÉ Technical Brochure No. 139, 1999.
9. DC side harmonics and filtering in HVDC transmission systems, CIGRÉ Technical Brochure No. 092, 1995