Chapter -1

Introduction

1.1.0 Overview of Operation Research Applications:

“Operations Research” is certainly concerned with optimization problems and leads to optimal decision. It is applied to solve practical decision problems of an engineering nature. It also includes classical optimization techniques – Non – liner and Dynamic programming inclusive of regression analysis. Thus, Operations Research attempts to find out the best or optimal solution to any problem/topic under consideration.

TQM (Total Quality Management) is a buzz word in all Mechanical Engineering Operations in any Industry. TQM has become a part and parcel of any small, medium or large scale industry. Successful implementation of TQM is always achieved through via Operations Research.

Analyzing critically the present status of operation and performance of industrial Units (Mechanical) appears to be the most essential step in this regard. Various techniques/methodologies of “Operations Research” could be utilized conveniently while analyzing the present status of Industrial units w.r.t. TQM inclusive of Total Energy Management (TEM).

Hence, typical cases studies to analyze critically various aspects related to TQM and Energy Conservation can be undertaken by considering some selected industrial sectors like Casting/ Foundry industry, Cement industries inclusive of mini cement plants, thermal power plants and chemical manufacturing units inclusive of refineries which are producing basic feed stocks.

Casting / Foundry Industry followed by Cement Plants are the two most important industrial sectors wherein Applications of Operations Research can be studied in detail. There exists vast scope to carry out indepth analysis of energy conservation opportunities and measures (ECOM) in casting/ foundry industry. Optimization of casting process parameters can be done conveniently by using fuzzy logic as well as by using Taguchi method. Cement Industry can benefit from implementing lean philosophy and Simulation Model can be developed. SWOT analysis of these industries can also be carried out. Energy conservation through design modifications and technical advancement also play a major role in these industries.

There exists a vast scope to carry out indepth analysis of energy conservation opportunities and measures (ECOM) in Thermal power plants also. Applications of six sigma methodology can be considered in thermal power plants to reduce the consumption of DM water.

Thermal Engineering Aspects as such are of Prime Importance in Chemical Industries also. However, it is observed in general that such aspects are least tackled / non at all tackled by Mechanical Engineers due to various reasons. Hence, probably for the first time, an attempt has been in this investigation to consider “Energy Conservation Implementation” in chemical industrial sector.

TQM is being complemented by these industries but in many cases it is at low key level. Hence, rigorous programmes can be prepared for the different selected cases under consideration for the purpose of implementation of TQM. It involves exhaustive data collection and optimization of various aspects related to TQM.

Statistical Process Control Technique can be utilized successfully to meet the needs of complex and large volume mass production process utilized in these industrial units. This technique tries to establish the pattern of process variability and uses it to predict the process quality and apply the necessary process corrections to keep the process under control.

Quality Control via Defect prevention, Optimal design of equipments, Design modifications and process modifications also involves utilizing appropriately ‘Operations Research’. When standard Mathematical formulation is not feasible, instead of Linear Programming, Dynamic Programming becomes essential which maximizes overall effectiveness. Implementation of final solution is a critical stage because it is here and only here, that the benefits of the study are reaped in industrial practice.
Network analysis (commonly called as “Net work flow theory”) is becoming most useful tool of operations research. Network analysis provides several useful optimization techniques for the design and operation of most network systems.

As already been pointed out, Industrial units in particular Foundries & Thermal Power plants are generally “energy intensive”. Some chemical units like Petrochemical units & Petroleum Refineries for basic Petrochemical feed stocks are also highly energy intensive. Hence, energy conservation in these units is the need of hour. Hence, Total Energy Management (TEM) is likely to play a major role in all such units. Mathematical Modeling” has been extensively utilized in Mechanical Engineering. Hence, “Mathematical Modeling” for some selected topics in Heat Exchanges Network (HEN), Mass Transfer Equipment Network (MEN) etc can also be tackled effectively via “Operations Research”. Implementation of HEN / MEN in Refineries & Thermal Power plants is the need of hour. The results and data obtained can be utilized in designing of relevant equipments and it is expected to result in saving in fixed cost as well as operating cost leading to optimum profit. In overall process, Mathematical Modeling thus helps indirectly in “TQM implementation”.

Application of modern techniques both production as well as managerial are yet to enter in majority S.S.I. units. The concept of TQM and it’s implementation by “Operations Research” itself seems to be far away from these one man manager enterprises. However, these appear to be a pressing need to study and analyze in detail the implementation of TQM in S.S.I. units like mini cement plants and small foundry shops.

Further, “Effective Utilization” of Non-Conventional Energy Resources-Hidden Energy (Heat of Reaction) has not been tackled at all. Total Energy Management (TEM) and TQM appear to be complimentary to each other. Implementation of TEM via HENS and MENS in industrial units is thus part and parcel of TQM.

Thus, there exists a full scope for study on “TQM Implementation via operations Research”.

1.2.0 Overview of Research Work:

Lion’s share of Operations Research is in implementation of TQM and TEM in industrial practices. Hence a “Systematic Comprehensive Study” on “Application of Operations Research in Mechanical Engineering” with major stress on TQM & TEM in different selected industrial sectors can be undertaken to deal with all the above mentioned aspect.

Various aspects related to “TQM and Energy Conservation” have been investigated and analyzed critically in this investigation for the following industrial sectors:

(1) Casting / Foundry Industries, (2) Cement Industries (large scale & medium), (3) Thermal Power Plants, (4) Mini Cement Plants – representative of SSI, (5) Selected Chemical Industries inclusive of refineries. Various Industrial units in the above mentioned five sectors have been visited for case study purpose. Field visits were arranged for relevant Data Collection for more than 55 industries which includes the following

(1) Eight Foundries:
1. Shining Engineers & Founders, Shaper,
2. Prashant Castings (P) Ltd, Rajkot,
3. Accutech Metal Pvt. Ltd. Meghdoot Foundry, Rajkot,
4. Sardar Casting Private Limited, Rajkot,
5. Kamani Foundry, Rajkot,
6. Gautam Technocast, Rajkot,
7. Patel Foundry, Rajkot,
8. Rasik Foundry, Rajkot

(2) Seven Cement Plants:
1. Ambuja Cement Plant of Ambuja Cements Ltd., Ambujanagar,
2. Gajambuja Cement Plant of Ambuja Cements Ltd., Ambujanagar,
3. Sanghi Industries Limited, Clinkerization & Cement Plant,Sanghipuram
4. Gujarat Sidhee Cement Ltd., Ta: Sutrapada, Dist. Junagadh,
5. Saurashtra Cement Ltd, Ta: Ranavav, Dist. Porbandar,
6. Digvijay Cement Co. Ltd., Jamnagar,
(3) **Sixteen Thermal Power Plants:**
1. Thermal Power Station, Sikka, Dist: Jamnagar
2. Saurashtra Cement Ltd, TPP, Ta: Ranavav, Dist. Porbandar
3. Ambuja Cement Ltd, TPP, Ambujanagar
4. Sanghi Industries Limited, Sanghipuram Captive Power Plant
5. Welspun Power & Steel Ltd., 43 MW TPP., Anjar, Dist: Kutch
6. Essar Power Ltd., TPP, Surat-Hazira Road, Hazira, Dist: Surat
7. Essar Steel Ltd., TPP, Hazira, Dist: Surat
8. Kutch Lignite Thermal Power Station, Panandhro, Ta: Lakhpat
9. Gujarat Electricity Board, Thermal Power Station, Ukai, Dist: Surat
10. Essar Power Corporation Ltd.(EPCL), Kumbhaliya
11. Vadinar Power Corporation Ltd (VPCL), Vadinar
12. Gujarat Electricity Board, Thermal Power Station, Gandhinagar
13. Power plant of Jindal Saw Ltd, Pragpar, Samaghoga
14. Power plant of Gujarat Heavy Chemicals Ltd, , GHCL Sutrapada
15. Power plant of Jaypee Cement Ltd, Abdasa
16. Welspun Power & Steel Ltd., 95 MW TPP., Anjar, Dist: Kutch

(4) **Nineteen Mini Cement Plants:**
1. Parasmani Industries, Bamanbor (Surendranagar),
2. Dhara Cement Industries, Koyba, (Surendranagar),
3. Kamdhenu Cement, Kuvadava (Rajkot),
4. Sharad Industries, Bamanbore, (Surendranagar),
5. Raghuvar Cement Industries, Metoda, (Rajkot),
6. Tapee Cement Industries, Metoda, (Rajkot),
7. Vikas Enterprise, Chikhli (Nasrani),
8. Rambo Cement Pvt. Ltd., Metoda, (Rajkot),
9. Mahuva Cement & Grinding, Bhadra, (Bhavnagar),
10. Kailash Cement Industries, Metoda, (Rajkot),
11. Toranto Cement Industries, Jamwali (Rajkot),
12. Ghanshyam Industries, Bamanbore, (Surendranagar),
13. Royal Industries, Hadamtaa Industries Area (Gondal),
14. Pruthvi Portland Pvt. Ltd., Veraval (Rajkot),
15. Shree Radheshyam Cement Pvt. Ltd., Chauta (Porbandar),
16. Shri Om Industries, Bamanbore (Surendranagar),
17. Mohit Cement Industries, Padra, Vadodara,
18. Sayona Cement Pvt. Ltd., Gondal, Rajkot,
19. Dharmkirti Concrete Pvt. Ltd., Ardo, Rajkot

(5) **Seven Other Industrial Units:**
1. Simalin Chemicals Industries Ltd, Nandesari, Vadodara,
2. Balaji Formalin, Motibhoyan, Taluka: Kalol, Dist.: Gandhinagar,
3. Omkar Chemicals, Nandesari, Vadodara,
4. Meru Chem Pvt. Ltd. Mulund, Mumbai,
5. IOC Refinery, Panipat
6. Reliance Refinery, Jamnagar,
7. Essar Oil Refinery, Vadinar.

Details of the above industries are provided in the respective chapters
**The entire thesis has been divided in to Ten Chapters and Chapter-(I) of the thesis deals with all the above mentioned aspects which are subsequently to be discussed in details in to different nine chapters.**