New Trend In Pump efficiency

Story of an Engineer....
Energy Saving Concepts…

1. Correct Sizing of Pipes, Bends & Valves
2. Power Factor Improvement
3. Changes suitable to variable head and flow
4. VFD for process optimization
5. Selecting right size & high efficiency motors
6. Right configuration of system
7. Periodic Overhaul

What about PUMP ???
We have derived $H, Q$, Suction pressure, working pressure & RPM.

What else is left?

Pump efficiency !!

Study

- $\frac{1}{5}$th of total power generated in the world is consumed by Pumps & Pumping Systems i.e. 20% of 21000 Tera Watt Hour (Source: enerdata.net 2010 Values) power produced.

- As per HIS pump efficiency reduces by 1.5% to 2% every year

*Pump has a Life Cycle Cost in it...*
Why does efficiency of pump decrease???

findings

• Chemical degradation – Corrosion

  Shaft deflection
  - Mechanically erodes diametric clearances
  - Reduction in mechanical seal life and bearing life
  - Increases pump vibration owing to residual unbalance
  
  Due to mechanical wear & tear
  - Wear ring clearance increases
  
  1.5 times of standard clearance = reduction in efficiency by 1.5 to 2.3%
  2 times of standard clearance = reduction in efficiency by 2 to 6%

For standard pump wear ring clearance increase by least 2 times in run of 8000 hours.
Finding...elements of Life Cycle Cost

Example

Let us consider a pump requiring 235 kW motor to drive. Energy cost will be

- 1,410 / hour
- 31,020/ day (22 hrs of operation)
- Mn 0.93 / Month (30 days)
- Mn 11 approx. / Year.
- Mn 120 approx. / for 10 years life

The initial cost of the pump motor equipment is about Mn 1.1
Only 1% of the running cost over its life period
**Contribution of Various Elements**

- ENERGY COST: 85%
- MAINTENANCE COST: 10%
- INITIAL COST: 2%
- OTHER COSTS: 3%

*Majority of buyers negotiate hard on this 1% of the Total cost.*

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**Need to develop new design with**

- Reduce chemical degradation
- Improve efficiency
- Reduce mechanical degradation
- Reduce down time
- Sustain Efficiency
Corrosion Restricted to 10+ years

Maintenance downtime reduces by 50%

Efficiency Improves by 3% to 5%+

Efficiency reduction is 0.25% every Year.
31-Oct-13

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Pumps put in operation...

### POWER SAVING CALCULATION

<table>
<thead>
<tr>
<th>No of Years</th>
<th>Motor rating KW</th>
<th>Motor efficiency %</th>
<th>Overall efficiency %</th>
<th>Power consumed Power saving Pumping cost Power saving &amp; Pumping cost due to Corrocoating</th>
<th>Total electiricity Cost In 10 Years for 1 pump</th>
<th>Total electiricity Cost In 10 Years for 3 pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37</td>
<td>86.5</td>
<td>82.6</td>
<td>235.28</td>
<td>1,885,497</td>
<td>5,400,476</td>
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<td>37</td>
<td>89.7</td>
<td>85.4</td>
<td>237.72</td>
<td>1,819,422</td>
<td>5,158,266</td>
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<td>37</td>
<td>92.1</td>
<td>88.3</td>
<td>242.01</td>
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<td>5,197,832</td>
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<tr>
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<td>37</td>
<td>94.4</td>
<td>90.6</td>
<td>247.15</td>
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<td>5,237,384</td>
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<td>37</td>
<td>96.6</td>
<td>92.9</td>
<td>252.92</td>
<td>1,833,136</td>
<td>5,277,820</td>
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<td>6</td>
<td>37</td>
<td>98.8</td>
<td>95.2</td>
<td>259.44</td>
<td>1,837,731</td>
<td>5,318,244</td>
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<td>7</td>
<td>37</td>
<td>99.4</td>
<td>95.8</td>
<td>264.98</td>
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<td>8</td>
<td>37</td>
<td>99.9</td>
<td>96.3</td>
<td>270.51</td>
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<td>5,399,076</td>
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<td>9</td>
<td>37</td>
<td>100.0</td>
<td>96.8</td>
<td>276.02</td>
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<td>5,439,482</td>
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<td>37</td>
<td>100.0</td>
<td>97.3</td>
<td>281.54</td>
<td>1,852,537</td>
<td>5,479,888</td>
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</table>

Result is...

<table>
<thead>
<tr>
<th>REGULAR</th>
<th>LLC</th>
<th>Difference</th>
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<tbody>
<tr>
<td>BEP Head</td>
<td>meter</td>
<td>37</td>
</tr>
<tr>
<td>BEP Discharge</td>
<td>m³/Hr</td>
<td>1925</td>
</tr>
<tr>
<td>Pump Efficiency</td>
<td>%</td>
<td>86.5</td>
</tr>
<tr>
<td>Motor Efficiency</td>
<td>%</td>
<td>95.5</td>
</tr>
<tr>
<td>Overall Efficiency</td>
<td>%</td>
<td>82.6</td>
</tr>
<tr>
<td>Motor Input</td>
<td>kw</td>
<td>235</td>
</tr>
</tbody>
</table>

Total Energy Consumption In One Hour kw-hr 235 227 kw-hr

Total Energy Consumption In 10 Years kw-hr 20,200,957 18,400,799 1,800,158

Total electricity Cost In 10 Years for 1 pump INR 121,205,742 110,404,791 10,800,951

Total electricity Cost In 10 Years for 3 pump INR 363,617,227 331,214,374 32,402,853

31-Oct-13

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### Environment Effect

<table>
<thead>
<tr>
<th>Years</th>
<th>Power Consumption kWh</th>
<th>CO2 Tons</th>
<th>CO2 Reduction</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Regular LLC</td>
<td>Regular LLC</td>
<td>CO2 Reduction</td>
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<tr>
<td></td>
<td>Power Consumption kW</td>
<td>Savings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regular LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Year</td>
<td>20,68,865</td>
<td>19,95,957</td>
<td>72,907</td>
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<tr>
<td>2nd Year</td>
<td>21,00,370</td>
<td>20,00,960</td>
<td>99,410</td>
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<td>3rd Year</td>
<td>21,32,355</td>
<td>20,05,975</td>
<td>1,26,381</td>
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<td>4th Year</td>
<td>21,64,828</td>
<td>20,11,002</td>
<td>1,53,826</td>
</tr>
<tr>
<td>5th Year</td>
<td>21,97,795</td>
<td>20,16,042</td>
<td>1,81,753</td>
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<tr>
<td>6th Year</td>
<td>22,31,264</td>
<td>20,21,095</td>
<td>2,10,169</td>
</tr>
<tr>
<td>7th Year</td>
<td>22,65,242</td>
<td>20,26,160</td>
<td>2,39,082</td>
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<td>8th Year</td>
<td>22,99,738</td>
<td>20,31,238</td>
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<td>9th Year</td>
<td>23,34,760</td>
<td>20,36,329</td>
<td>2,98,431</td>
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<tr>
<td>10th Year</td>
<td>23,70,315</td>
<td>20,41,433</td>
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<tr>
<td>IN TEN YEARS</td>
<td>2,21,65,532</td>
<td>2,01,86,193</td>
<td>19,79,340</td>
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</tbody>
</table>

### Benefits of Lowest Life Cycle Cost™

- Sustainable Efficiency
- Supreme Longevity
- Reduced Downtime
- Ease of Maintenance
- Energy Savings
Conclusion

**ROI of 9 months to One year**

"THIS IS A CRADLE TO GRAVE SOLUTION"
With Minimum cost to Maximum Benefits
New Trend In Pump efficiency

.....Sustainable Efficiency

HIS ...about efficiency drop in a pump..

Figure 1.78B — Estimated efficiency decrease due to increased wear ring clearance (US Units)
## Analysis of Pump Power Consumption Pattern

### Table: Pump Power Consumption Pattern

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>No. of years</th>
<th>Over all Efficiency</th>
<th>Pumping cost (in Rs.)</th>
<th>Power tariff Considered: Rs 6/KWh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Per Day</td>
<td>Per Year (Mn.)</td>
</tr>
<tr>
<td>1</td>
<td>1st year</td>
<td>82.60</td>
<td>30,994</td>
<td>11.16</td>
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<td>2nd year</td>
<td>81.36</td>
<td>31,466</td>
<td>11.33</td>
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<td>80.14</td>
<td>31,945</td>
<td>11.50</td>
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<td>4</td>
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<td>78.94</td>
<td>32,431</td>
<td>11.68</td>
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<tr>
<td>5</td>
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<td>77.75</td>
<td>32,925</td>
<td>11.85</td>
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<tr>
<td>6</td>
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<td>76.59</td>
<td>33,427</td>
<td>12.03</td>
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<td>7</td>
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<td>75.44</td>
<td>33,936</td>
<td>12.22</td>
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<tr>
<td>8</td>
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<td>74.31</td>
<td>34,452</td>
<td>12.40</td>
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<td>9</td>
<td>9th year</td>
<td>73.19</td>
<td>34,977</td>
<td>12.59</td>
</tr>
<tr>
<td>10</td>
<td>10th year</td>
<td>72.10</td>
<td>35,510</td>
<td>12.78</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>120</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Reducing chemical degradation

Surface roughness comparison

**Cast iron Ra 18.8 µm**

**Mildly Polished Steel Ra 5.0 µm**

**Fluglide 'E' Ra 0.4 µm**

**Fluglide Ra 0.08 µm**

**Layers of glass flakes**

**Tortuous path for corrosive ion**

**Coating**

**Glass flake fluiglide coating**
Coating on Internal parts...

Features of Coating ...

- Anti Corrosion
- Anti- Abrasion
- Anti-Galvanic
- Hydrophobic
- Improves Efficiency
Mechanical Degradation.... Shaft Deflection

Low L^2/D^4 ratio ensures minimum deflection and long bearing life.

Mechanical Degradation.... Wear Rings

Hard Metallic serrated wearing
Precision casting in **austenitic stainless steel as standard**. Axially hydraulic balance of double suction design improves efficiency & Bearing Life.

Reducing mechanical degradation and down time

- Externally removable bearing housing
- Universal seal chamber
- API type double row thrust bearing assembly
Reducing down time

Mechanical Seal Replacement
Horizontal Split Case Pumps

- Remove guard
- Remove spacer
- Remove bearing retaining nut
- Remove bearings and remove mechanical seal
- Remove pump coupling
- Remove bearing housing

Assemble for use