

## Assessment of Pump Technology Development

This article discusses current technical trends about production and development of pumps besides Total Life Cycle costs which affect pump technology development dramatically.

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Future developments can be designed extrapolated and influenced by observing current trends. Future developments are just imaginable. As far as the pump's production is concerned, more and more machining of parts can be substituted by precisely made raw parts. This can be achieved by precision casting, die-casting, sintering and deep drawing. Those modern technologies together with modernised workshops by applying "Lean production" and "Just-in-time-logistics" are suited to drive the costs down.

In the area of product development one can observe that new materials and material coating can improve reliability and lifetime of existing pump designs for many fields of application. One basic question arises that whether all these trends will change the basic design of pumps also, if not, why? In fact, these trends will not change the basic design of pumps practically. The reason behind is the various specifications and design features.

There are too many standards and specifications for design features, which hinder a real technical progress. This is particularly the case with pumps for the process industry.

On the other hand the future opportunities for European pump manufactures will mainly come from an innovative pump design. The question is what obstacles have to be overcome in creating an innovative pump design. At first, customers have to accept a new but more revolutionary design and forget all the detailed specifications about design features.

Secondly, there is an evaluation method to be established, which will automatically lead to a design philosophy that stimulates pump technology innovation. The best way for simulating innovation is to determine the customer's value of innovation at the procurement phase of a pump.

This can be done by calculating the total of all costs over the life time of a pump, the so called, "Total Life Cycle Costs".

### These May Be Described As Follows:

Definition of Life Cycle Costs

1.  $LCC = I + LCC_E + LCC_M + LCC_{ENV D}$  where:  
 $LCC$  = Total Life Cycle Costs  
 $I$  = Investment Costs  
 $LCC_E$  = Life Cycle Energy Costs  
 $LCC_M$  = Life Cycle Maintenance and Repair Costs  
 $LCC_{ENV D}$  = Environment Costs during life cycle and final Recycling Costs.

All cost elements have to be calculated discounted interest cost elements. Related to the investment costs this equation leads to:

$$(2) \quad LCC = I \left[ 1 + \frac{LCC_E + LCC_M + LCC_{ENV D}}{I} \right]$$

There is a representative centrifugal pump, which is frequently used, in the chemical industry with the following performance data:

flow rate	: 18 m <sup>3</sup> /h
head	: 55m
pump efficiency	: 50%
speed	: 2900 rpm
power consumption	: 6 kW

### If We Make The Following Assumptions:

continuous operation at full load	: 6000 hours/year
specific energy costs	: 0.10 DM/kWh
life cycle	: 20 years
mean time between failure(MTBF)	: 30 months
average costs per maintenance and repair	: 3.000 DM
investment costs	: 6.000 DM

The total Life Cycle Costs according to equation (2) are approximately:

$$LCC = I(1 + 12 + 3,5)$$

An energy saving by 50% means a possible increase of pump efficiency by 50-75% would compensate the investments costs roughly 6 times (during the total life cycle of the pump).

On top of this, an extension of the meantime between failure by a factor of two from 30-60 months would compensate the investment costs by a factor of 1.75.

- ❑ The end user's value is a lot higher if he asks for energy saving pumps with a longer MTBF instead of a possible discount on the investment costs.
- ❑ During the procurement phase of pumps, which have a long life cycle and are continuously operating, the consideration of the Total Life Cycle Costs is mandatory.
- ❑ It seems that opportunities for European pump manufactures will come from a new approach on a clean sheet of paper where we may bring together all our innovative ideas to meet the real needs of our customers by means of a more revolutionary pump design.

### Customer's Requirements

- ❑ long life cycle – as long as the plant has
- ❑ lowest possible operating expenditures
  - lowest possible energy consumption
  - without any local operators
  - easy to remove or install
- ❑ highest possible reliability
  - meantime between failures above 50,000 hours
- ❑ less sensitive or protected to misuse
  - eg, able to run dry or handle gas/liquid transients
- ❑ environmental-friendly
  - leakage-free
  - easy to decontaminate
  - easy to recycle
- ❑ 50-60 Hz operation

A pump with a long life cycle should consist of wetted parts made of high corrosion- and erosion-resistant materials using for instance newly developed coatings, duplex steel, plastics like PAEK or ceramics and Titanium. The speed of this pump could be selected according to the most favourable specific speed to attain a high efficiency. The lowest possible energy consumption could be achieved by using a frequency controlled motor and by a pump performance self-adjusting to the actual demand of the plant. The pump should have no shaft seals. It needs no oil lubricant, no base plate required or coupled. By using pumpage lubricated bearing or magnetic bearings, there will be no wear on them. The use of a frequency control in combination with low cost sensors and a low cost microcomputer would provide enough sensitivity and intelligence to protect the pump against misuse. On top of this, an early failure detection or tele-monitoring system could grant a maximum of availability. Such pumps can be applied either with 5 Hz or 60 Hz without any difference and run in wide speed range dependent on the NPSH available on the flow rate. The total performance range with best efficiency would be much wider than available.

The investment costs of such a " smart pump" will probably be higher than for the conventional designed one. But even if the price is doubled, the Total Life Cycle Costs would be drastically lower.

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### Reference Book:

Chemical Engineering World,  
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