Development (design and systematization) of HMS Group pump ranges

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Abstract. The article reveals the need for pump range charts development for different applications and describes main principles used by HMS Group. Some modern approaches to pump selection are reviewed and highlighted the need for pump compliance with international standards and modern customer requirements. Even though pump design types are similar for different applications they need adjustment to specific requirements, which gets manufacturers develop their particular design for each pump range. Having wide pump ranges for different applications enables to create pump selection software, facilitating manufacturers to prepare high quality quotations in shortest time.

It is obvious that perfect choice of pump equipment complying with the customer's hydraulic technological system requirements is the key for its most efficient application. The customer will choose those pump producers who may offer the most efficient pumping equipment capable to work in required operation modes and comply with modern technical standards and requirements. As a result nowadays the availability of a proper pump which meets the customer requirements is a must for any pump manufacturer.

In former USSR the pumping equipment used to be specifically designed and developed for particular needs and technological systems. Unfortunately such approach has led to scarce range of the pumping equipment. That is why Customers often had to adopt and develop their own hydraulic system in accordance with available pump range which certainly affected the whole system's efficiency and energy consumption. So that huge energy saving potential can be utilized after Customer hydraulic system energy audits and proper selection of modern pumps and their replacement as a result.

Today the situation has ultimately changed. Actually the market is over saturated with the pumping equipment produced by numerous overseas companies, which may offer a wide range of all types and models of the pumping equipment. Such assortment has been developed for decades, counting for the world market pumping equipment needs. Naturally a number of national pump manufacturers couldn't meet the competition and either closed down or dramatically decreased their production facilities and sales. Now they are faced up with a challenge to catch up with competitors and keep to the pace of the world technological progress. This challenge first of all imposes the urgent need for proper pump designing.

How has HMS Group taken up that challenge and defined strategy for working out ultimately new approach to pump development? How the process shall be optimized and how to become competitive
in the world market of the pumping equipment? These are the rhetorical questions. But the implementation of such ambitious plans involves considerable resources, primarily intellectual ones.

In the highly competitive market it is essential to understand what customers are looking for and what are the criteria of their choice? Obviously the pumps must comply with international standards for certain industry as well as availability R&D potential and a wide range of pump types. Naturally the pump industry is steadily developing, existing standards are being regularly updated and new editions are released. This pushes the pump manufacturers to rise their awareness of innovations as well as to join the new standards development process. It enables them to upgrade timely their pumping equipment. That is why most companies strive to become members of national and international professional associations such as RPMA in Russia, HI in USA and Europump in Europe.

Analyzing the production ranges of the leading pump companies it is highlighted that despite the similar type of design, companies are obliged to develop in each pump range different real design and use a wide range of materials in compliance with a particular standard. The costs vary accordingly. For example, the cost of overhanging pump for pumping water and API 610 overhanging pump for the same parameters differs considerably. Hence currently it is impractical to develop universal pump range for different applications and pump manufacturers have to have specific pump ranges to comply with particular standards (API, DIN, EN, GOST), as well special technical requirements of Customers, such as nuclear power stations, oil transportation, etc. For example, HMS Group pump types for different applications are shown in Figure 1.

However, having the most modern pump which corresponds to the latest standards, but if it is not optimum with the parameters Q, H and efficiency for the required operating point, it will not be accepted by the customer or lose in competition: Figure 2 [1].

![HMS Group pump types for different applications](image)

**Figure 1.** HMS Group pump types for different applications.
Despite the fact that the pump B has a higher Efficiency at BEP, pump A actually has a higher Efficiency than pump B for the required flow rate. This raises the task of the "right" designing of the whole pump range. In the professional literature there are various tips how to design pump ranges. For example, in the reference [2] authors determine the basic pump range with flaw rate ratio 1.75, the head with coefficient 1.45 (Figure 3), and develop a whole pump range, using the laws of similarity, that only enables to design a few basic hydraulics, and to apply the results of their tests to other pump sizes in this pump range.

Reference [3] specifies the coefficients 1.5...2 for flow rate and 1.26...1.75 for head and reference [4] proposes to take variable coefficients. Author [5] makes accent on modern capabilities of CFD and fast wetting parts design using CFD analysis. The diversity of these recommendations is apparent and caused by the desire of different pump companies to find some optimized quantity of pumps for a certain pump range, which on the one hand would meet the customer needs while on the other hand does not require the development of additional pump sizes, because the amount of investing costs is
proportional to the number of designed pumps. Systematization and standardization of pumps in the form of pump range facilities companies to improve planning R&D work, working out better hydraulics, mechanical parts of different pump types, various calculating methods and regularly develop the necessary test facilities, etc.

Currently, the technical requirements of Customers dictate the desired location of the pump duty point. This is usually 0.8…1.1Qbep, as seen on Figure 4.

![Figure 4. Requirements for the duty point location.](image)

If one accepts this requirement as a base, the boundary of each pump range should be chosen so that the point with 1.1Q of previous pump size bordered with 0.8Q for the next size. I.e. the step of flow rate shall be not more than 1.1/0.8 = 1.375. In this way the number of pumps increases significantly and many manufacturers are going to create additional rotors or special wetting parts [6] within one pump. As a result, the distance between the basic pumps’ flow rates can be increased, but the costs of neighboring sizes it shall be taken into account. Most of the HMS Group pump range charts have 2 or 3 flow part within each pump size as Figure 5 shows. In addition to reducing the number of pumps such approach helps to obtain more flexibility to select pumps by the Customer requirements.
In our view, the following approach especially for engineering the pumps can be quite perspective when a pump’s wetting parts within its range are "redesigned" according to customer requirements, and the impeller and casing or diffuser are manufactured using modern additive technology or other methods of quick 3D manufacturing. Thus, one can get an endless quantity of flowing parts within the same pump size. Such approach will involve consideration the other principles of working out the range chart when characteristics and BEP flow rates of neighbor pumps are not at first place, but the ability of each pumps to provide a wide range of Q and H parameters as well as the cost of the basic pump, depending on the pump size.

In some cases, for pumps of special applications, for example, slurry pumps, each pump range chart shall include information on the narrower operating range and enables pumps to work at lower speed in extreme conditions with varying concentrations of additives in pumped liquid, etc.

Having a developed pump range, each pump characteristics, design and estimated pump costs the selection process is easy to automate. Today there are many commercial software products using manufacturers’ databases, which have become a handy tool. For example, HMS Group has been using for many years the SPAIX program for industrial pumps selection (Figure 6) in addition to some own software for the selection of specially engineered pumps and the ones complying to the API standards.
Figure 6. Pump selection using SPAIX software.

This software helps pump manufacturers to be competitive and prepared with high quality quotation in the shortest time. At the same time the designers, whose working time is very expensive, are not involved in the selection process of the pumping equipment, so the sales persons using this software can quickly respond to customer requirements. In fact, the pump selection software is a logical embodiment of knowledge and experience possessed by the manufacturer of pumping equipment.

Conclusions
1. The availability of the modern optimized pump ranges is currently a must for successful work in the market.
2. Pumps with certain design type shall not only pursue obtaining the necessary parameters at any duty point within the chart range, but also comply with international standards and the specific technical requirements of different customers.
3. Pump ranges shall not be considered as something immutable. They can and shall be updated in line with advances in technology and changes according to Customer requirements.
4. The wide pump ranges enables pump manufacturers to develop the software on their base and provide the pumping equipment selection with a wide functionality and maximum customization.

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