Petrol Pumping Systems - The Drive for Change

Changes in gasoline marketing and service station design are having an effect on the method of pumping fuel. How submersible pumps overcome the inherent limitations of suction pumping are explained in this timely article by European petroleum expert, Jamie Thompson.

Changing from suction to pressurized pumping

Development of the
Service Station in Europe

Historically the first distribution of petrol in the early 1900's was by the 2-gallon can, which was poured into the vehicle via a funnel; there were not enough vehicles on the road to warrant the installation of any thing larger. As the motorcar sales grew the need for an improved distribution system brought about the first underground tanks and pumps. These tanks were quite small with the pump usually immediately above the tank and were hand-operated pumps based on a suction system, with a foot valve situated in the base of the draw off pipe in the tank. Many of these sites were kerb side sites with the pump being situated on the side of the road where the car could pull up and be filled.

Later service stations "off the road" were developed but these were still very small in size and as sales and technology developed the first electric driven suction pumps were introduced which assisted the operator to deliver petrol to the customers car.

In those early days the petrol filling stations developed as an addition to an existing business providing added benefit for existing customers, they were generally quite small and there were many such premises. With the introduction of self-service filling stations in the 1960's the design of the petrol station layout became more important, the tanks were moved away from the dispensers, road tankers could fill without disturbing sales and for the first time engineers had to become more aware of the limitations of the suction pump which had been the preferred system for distributing petrol in Europe.

Physics and Economics
are Driving Change

When we examine the changes within the industry in Europe at present we see an increase use of the

pressure pumping systems that had traditionally favoured the suction system and there are good practical, economic and indeed environmental reasons for this gradual change.

The physical limitations of the suction system can be calculated and depend upon a number of critical factors and more importantly in recent years the chemical nature of fuels we are now using are reducing those limitations further.

Let us examine these limitations

- The suction pump situated at the dispenser has limitations of pull to a depth of approx 4m, which is measured from the bottom of the tank to the level of the suction pump. With larger tanks being installed of up to 3m diameter, there is not much room to play with tanks being installed 1m below ground

- The maximum length of run for a suction pipe to operate successfully would be approximately 60m after which pumping problems will occur

- These limitations are based on calculations at sea level and with installations at higher altitudes the limitations are much lower

- The changing specification of the fuels that we now use has also contributed to a worsening situation regarding suction systems.

- More unleaded, higher octane fuels with increasingly more additives are making it more difficult to use suction pumps within the limits described above

- The more gaseous nature of the fuels cause cavitation on a suction pump and causes vapour lock when the whole systems stops

- The problems are exacerbated in the summer when warm weather heats up both the product and lines, again causing vapour lock and the subsequent dispensing problems

Service Station Design

In all European countries the drive of the oil industry is for larger more efficient sites with the smaller sites closing and the larger sites with other profit centres being developed to serve the changing customer needs. This change of design ensures that the road tanker stand is situated well away from the dispensing in order to allow petrol deliveries to take place without interfering with pump sales. The size of the sites is increasing with car parking provided for the customer who also visits for non-petroleum sales.

The European engineer traditionally used to the suction system, now has to examine the option of using submersible pumps if wishing to retain flexibility in the design of the site.

Although this move towards pressure systems has been driven by the physical nature of the site and

the limitations described above, the more enlightened engineers are also praising the economic virtues of using submersible pumps in this cost conscious environment.

Cost Comparison

Perhaps the best way to examine the cost advantages of using a pressure system is to compare the construction of a new service station using the different systems.

You will see from this layout that the amount of pipe and equipment used in a suction system far exceeds that in a pressure system.

Suction System	**Pressure System**
12 pumps	3 pumps
12 motors	3 motors
12 air eleminators	3 integrated eleminators
12 pulleyes/belts	0 pulleyes/belts
1 pipe run per unit	1 pipe run per grade
12 units = 12 piping runs	3 grades = 3 piping runs

You will see from the above tables that there is a clear economic advantage in building service stations using a pressure system with 75% less piping delivering the same product to the customer. There is sufficient saving in the dispensing equipment alone to be equivalent to the cost of three dispensers!

On Going Savings in Maintenance

There is also clear evidence that the savings do not stop there with even greater savings being made on the maintenance of equipment. Using pressure technology means there are less motor/pumping systems working at the station. Less moving parts to break down means lower maintenance costs. Experience has shown that failure of submersible pumps is extremely rare. They have a proven track record with excellent reliability and reduced down time, one of the reasons for this is that they operate inside the tank in ideal conditions, submersed in fuel, which cools and lubricates the motor. There is the added bonus of reduced energy costs, which also contributes to increased profits.

Environmental Considerations

As an ex regulator I had concerns as to the past performance of pressure systems in an environment where leaks frequently occurred, and with the that in mind the industry has certainly responded over the years to meet those challenges offering both new materials and technology to reduce this risk considerably.

The use of unprotected single wall steel pipe work, which historically caused such horrific leak problems for service stations all over the world, is thankfully a thing of the past. Engineers constructing service stations using pressurised systems at this present time have such a wide choice of non-metallic pipe work suitable for operating at high pressure often secondarily contained with built in leak detection devices.

The sophistication of mechanical and electronic line leak detection systems supplied with the submersible pumping system enable lines to be automatically tested for substantial leaks (12 litres per hour) operating each time the pump stops and the delivery cycle ends. In more sensitive environments lines can be checked to a finer test (0.38 litres per hour), at predetermined intervals. These tests only form part of the whole systems, often secondarily contained, and designed to keep the pressure pumping system operating safely and efficiently in any environment.

Jamie Thompson joined the London County Council in 1961 and trained as a Petroleum Inspector and ended up as Principal Petroleum Inspector for the London Fire Brigade the largest petroleum authority in Europe. He has specialised in petroleum standards, construction, legal enforcement, equipment approval and new design of Petrol Filling Stations for well over 40 years. He is currently chairman of European Standards committee (CEN TC 393) dealing with equipment for service stations, which has produced 23 European standards relating to filling stations. He also chairs CEN TC 265 WG8 on underground and above ground storage tanks, and sits as a European contributor to the Underwriter Laboratory standards for fuel tanks and fuel lines in the USA. He was Editor of the APEA Technical Journal “The Bulletin” for 23 years and as Chairman of the technical committee of the APEA he is involved in the publication of the APEA/EI Guidance on design and construction of filling stations known as the Blue Book.