The “B” type Bush Pump. Hints on maintenance

The Bush pump in one form or another has been used in Zimbabwe for over 60 years. In its most modern form, the "B" type Bush Pump head, which was standardized in 1989, is most commonly used with standard "down the hole" components, comprising 50mm nominal bore galvanized steel rising main, 16mm mild steel pump rods, a 75mm diameter brass cylinder operating with a piston fitted with two leather seals and a brass foot valve. These components are well tested and durable.

Most pump repair or maintenance jobs on the Bush Pump are undertaken on "down the hole" components where it is essential to remove the pipes to inspect the parts underground. The pump pipes are heavy to lift and special lifting tools are required. Ideally such tools should include a tripod and block and tackle, and at least large spanners and pipe clamps. The routine replacement of piston seals, which is the most commonly undertaken maintenance procedure, necessitates the removal of all pipes and rods in order to gain access to the piston and its seals. User friendly Bush Pumps with open top cylinders where the rods and seals can be removed without removing the pipes have been designed and field tested in Zimbabwe, but the great majority of pumps use the standard “non-extractable” components.

The Pump in practice

What can go wrong with the pump?

Pumps which are very heavily used or pumps placed on very deep boreholes come under great strain and may need more regular attention. The Bush Pump is capable of withstanding a lot of abuse however and will still operate when many of its bolts are missing. It can be adapted for use on wells which are one metre deep or to boreholes which may be over 100m deep. The single characteristic of the Bush pump is that it is very adaptable and forgiving unit.

1. Maintenance of the pump head.

The pump head is a robust unit and will continue to operate effectively for many years with minimal attention. However like any other machine, it will suffer if badly abused over a prolonged period. The essential requirement is that all the pump head bolts are kept tight. The most critical bolt is the rear head bolt. If this is allowed to come loose, wear will take place on the head bolt and main pump head frame, and eventually the pump head will require refurbishing. The floating washers last for several years, and may require replacing every 3 - 4 years. Their life depends on the usage.  If the upper rod is not kept tight in the pump head U bracket, the rod socket threads in this bracket may wear and need renewal. It is also desirable to place an old car tyre in the ground behind the pump to act as a buffer and lower stopper for the handle. The rubber buffer placed on top of the floating washers may also need replacing after some years. There are few other wearing parts. The wooden block should last for at least two decades. For the pump head the answer is to keep all bolts tight - and spanners are essential for this purpose. Special spanners have been designed.

2. Down the hole components

Most of the maintenance of the Bush Pump is concerned with parts which lie below ground level. Maintenance and repair of “down the hole" parts include:

1. Replacement of leather seals
2. Attention to faulty or worn rising mains
3. Attention to faulty or worn pump rods
4. Attention to leaky foot valves
5. Attention to faulty piston valves
6. Attention to faulty or worn cylinders

Many problems occur because the parts are poorly made in the first place. Defective pipes, rods, cylinders, piston valves and foot valves are not uncommon. Shoddy work in the factory will inevitably lead to repeated problems in the field. Also problems occur when the pump is poorly installed. Many problems occur because the parts are not properly inspected, cleaned and fitted together carefully and tightly. The pipe threads should always cleaned and plumbers paste or tape should be used on the threaded joints. When the paste is used the pipes are better sealed against leakage and also easier to separate when the pump is dismantled. This extends the life of the pipes.
2a. Replacement of piston seals.

Most seals in Zimbabwe are made of leather and this forms an excellent material for the piston seal. The leather is able to absorb small particles which rubber or plastic seals may have difficulty in coping with. The twin leather seals of the 75mm piston may last for 1 - 3 years depending on quality of the seal, working conditions and quality of the water. Seal life is also influenced by the quality of the cylinder, specifically the smoothness of the internal cylinder surface. Seals should be replaced by new seals of the highest possible quality. Replacing seals with partly worn or poor quality units will increase the overall cost of maintenance. Leather is a unique manufactured product made by tanning through a chemical process to preserve the hide permanently, whilst at the same time retaining the natural fibrous structure from which leather's ultimate strength and pliability are derived. During the manufacture of high quality leather seals the leather is impregnated with oils which fill the fibres and yet still allow the water to be absorbed into the microscopic spaces between the fibres. Thus the seal remains flexible for the whole of its life unless it dries out. Leather absorbs and takes in small particles of sand and grit and so preserves the smooth finish of a well made cylinder bore.

When fitting new seals always check the whole cylinder. See if the check (valve within the cylinder) is jammed. Also check the piston itself. The piston valve (poppet) should move freely and make a good seal on the valve seat. Discard old leather seals (cups). After the new seal is fitted tighten up all the components of the piston assembly. Make sure the lock nut is tight on the rod which enters the piston head. Clean all the parts of piston and cylinder. It is wise to check the cylinder assembly and the foot valve in a bucket of water before it goes down the hole. The foot valve must hold water – no leaks.

2b. Attention to steel pipes

These are expensive components. Pipes last longer in softer water (where the pH is about neutral) and their life is reduced as a result of corrosion in more aggressive, acid water. There is much variation in the quality of water being extracted even within a single district. Where the water is more aggressive, the pipes turn brown with rust, and holes may develop at weak points in the assembly of the pipe (i.e. down the weld line). In general pipes can be expected to last for at least 10 years.

Several factors influence the life of the pipes (rising main). Pipes vary greatly in quality and thickness. Obviously the best pipes give the longest service. Thin walled and poor quality pipes may look similar to strong thick walled pipes, but in every other way they are not. Choose good quality pipes for longer life. Sometimes a hole develops in the welded seam of the pipe. However most pipes deteriorate at the joints where they are threaded. This is because the protective galvanization is worn off at this point and is the most subject to corrosion. This is also the part which suffers the most damage during dismantling and assembly of the pump. Consequently pipe life is reduced as a result of constant removal and reassembly. Rough handling also reduces pipe life, where pipes and their threads may become dented or damaged in other ways. Thus where piston seal life is longer, the pipes require removal less frequently. This will occur when high quality seals are used and where the water is clear and does not contain fine silts. Clarified well water is ideal, but most Bush Pumps work on boreholes. Properly developed boreholes should yield water of high physical quality. But many may not reach this standard.

Such damage or wear on pipes is much reduced if the pipe is rarely touched. Evidence for this can be seen in the life of pipes used in the mono pump which is driven by an electric or diesel pump fitted at the head. Once properly installed the down the hole components are rarely lifted. In this case the pipes may last for up to 15 or 20 years.

The easiest way of extending pipe life is to use plumbers paste (Plumber’s Delight) in the threading when joining pipes. This makes a good seal and helps to reduce corrosion. It’s use thus lengthens the life of the pipe. Pipe joints should be done up tightly.

2c) Pump rods

The most common problem with pump rods is separation at the joints. This is often due to loosened or worn threads on the rods and rod sockets (connectors). 16mm mild steel rods usually last for at least 5 years and up to 10 years. Once again the weakest part is the threaded end. Rod separation in conventional components can result from erosion of the thread behind the lock nut. Once the lock nut is loose the main rod socket can unscrew and rod separation results. Simultaneously the threads of the rod are spilt. New threads cannot easily be made on older rods, where the diameter is being reduced. Consequently old rods, which may have
sufficient strength, but not enough diameter for threading are thrown away. In the case where they are
rethreaded because budgets do not allow for replacement by new parts, the number of breakdowns due to rod
failure increases further. Rods may also crack, most commonly in the threaded section. Thus is normally due
to excessive strain on the parts, due to great depths or defective rods. 16mm rods are much sturdier and last
much longer than 12mm rods and have been used as the national standard for many years. It is obviously
important to ensure that all the joints are done up tightly and that each rod occupies half the socket. If the rod is
only partly screwed into the socket, the joint will separate earlier. It is also important to ensure that the rod
joints and the pipe joints do not meet at the same point as this will lead to unnecessary friction and wear.

2d) Foot valve

If foot valves leak, the pump will produce less water per stroke and will require some priming on every occasion
it is used. This may take some time especially on deeper boreholes. This extra pumping can place extra and
unnecessary strain on the pump head as well as the users. It is essential to choose and good foot valve in the
first place. The standard heavy duty foot valve has always been recommended for use in Zimbabwe. It is a
thoroughly tested and well established unit and gives reliable service then properly manufactured and
installed. The foot valve should always be dismantled, inspected and cleaned before use, even when new.
Check that the rubber seat and the brass valve make a good seal. Do not use faulty users. They should be
sent back to the manufacturers. Screw the unit up tightly. A hard rubber seal fitted in a slot should make the
unit water tight under the brass valve. The brass valve has fins which make the unit turn during use, thus
providing even wear. This seal may take up to ten years to wear down. This unit is reliable and rarely needs
attention. It is important to check the foot valve thoroughly before final assembly. The standard Zimbabwe
cylinder also has a foot valve in its base known as a check valve. This serves as a second back up unit to hold
water up in the rising main. When one considers that some pumps in Zimbabwe pump up water from the
height of the Victoria Falls, then one sees why a back up may be desirable.

2e). Piston assembly

Usually the piston fails because the seals are worn or other parts of the unit unscrew and fall apart. The piston
unit itself may unscrew and separate from the rod. The lock nut used to secure the piston unit to the rod should
be done up tightly. Occasionally the valve (poppet) itself may fail or become jammed. This is mainly due to
faulty manufacture or fitting. Use good seals and tighten up all parts of the unit correctly.

2f). Cylinder

Cylinders should rarely give trouble if properly made and installed. Sometimes cylinders leak because the end
caps have been screwed up with too much force. The unit is made of brass which is a relatively soft metal.
Care is required. The end caps should be done up tightly, but not with excessive force which may result in the
cracking of the end of the cylinder. Note the cylinder is made of soft brass and should always be handled with
care and never held in a vice or pipe wrench. The end caps should be used to attach spanners whilst the
rising main and foot valves are fitted. Cylinders wear out more quickly if the water is silted or filled with sand.
Properly drilled and developed boreholes and dug wells should not provide water with poor physical quality.
The foot valve should not be too close to the base of a well. Half a meter is a minimum.

Conclusions

Choose well made pumps which are built according to specifications. Check on the pumps. An inspection
chart is available. Choose well made down the hole components. Poorly made pumps do not last. Also the
pump must be installed correctly and carefully if it is to provide a long and reliable service to the community.

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