TRENDS IN SERVICING HYDRAULIC MACHINERY IN LOGGING : FROM 1950 TO 2000

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INTRODUCTION

Wynne Cranston:

There's so much hydraulics out there in logging that we decided we would categorise it into three groups, namely the past, the present and the future. I'm going to spend a few minutes on the past and the present, and then Kevin's going to give you a few more minutes on the present, and then, if there is time, we'll just dip into the crystal ball and tell you what we think the future holds.

THE PAST

By the past I mean the 1950's and '60's, and that really is the original hydraulic equipment. These were the days of the Hamilton shovel loader, and the skidder made from a David Brown tractor, with a gear pump on the front etc. Now those days, the hydraulic system had a cast iron gear pump or a vane pump, pretty loose tolerances, a valve and a cylinder. The oil circuits usually ran hot, the clearances were loose, the air got entrained in the oil and there were oil restrictions in the piping through the use of galvanised elbows and that sort of thing.

Any lubricating oil would do. You poured it in at the beginning, and you poured it in frequently during the course of machine operation, because it used to leak a lot. Dirt in the oil was common, it went in at the beginning and more went in every time you poured some in from a dirty bucket, or an old can. But there was dirt in there to start with. The manufacturers left in welding scale in the tank, iron filings in the pumps, cast iron dust and moulding sand in the valves, rubber slivers in the hose, manufacturing swarf from the machining, and grinding dust was added in the plant. The grinder was busy working over there while a man was welding up the tank over here, and it all got mixed in together. The wear products created in the equipment circulated freely so that the contamination level went up rapidly. Filters were not popular. Nobody could bother changing the elements if there were filters.

Now a diagnosis in these days of a fault was entirely by the operator. He called back or got in in the afternoon and said "The pump's just died". That's about all he could tell you, and then he and the boss took the pump to pieces and with the eyeball and the fingernail, they said: "badly worn" if you could feel a bump that high, it was badly worn.

The servicing was relatively easy, you just got a few spare parts from somewhere, and provided they fitted in you put the bolts back in and away it went. The clearances were so loose that almost any new part was better than the old part. Now it's true that some of these machines are still running today. In the oldest of the skidders, I think some of them are still about.

Now one other thing we must tell you there, the power transmitted by that hydraulic system was only a small proportion of the engine power, maybe 20%. Typical pressures were around 100 bar (1500 psi) and the oil pipes were usually 3/4 inch and 1 inch.

THE PRESENT

Now in the 1970's and 1980's, which I am describing as the present, all of those things changed. The flow control and the variable delivery piston pump meant that now you could have speed control on your machine, and variable speeds. The hydraulic motors, of which a profusion were designed and developed, meant that anything that turned could be driven by a hydraulic motor. This usually meant the wheels of the machine, the feed rollers, the conveyor belt, the chopper, the slasher etc. There was a hydraulic motor for every one of those.

Now, because the equipment got more efficient, like frequently 90% or better, the heat developed in the circuit was less. Oil coolers became more common, the heat was now controlled. Filtration became commonplace, 10 micron filtration became mandatory. Everybody knew that you needed a 10 micron filter, and they bought them and they serviced them. The manufacturing and the assembly dirt was taken out. People learned to cover the tank after they'd made it, and to clean it out of the welding scale before they poured in the oil. They even learned to pump the oil in via a filter, because the oil you purchased from the oil company was not guaranteed to be clean.

The hydraulic oil itself became a sophisticated medium. It had to have anti-wear additives as well as anti-foam additives,and anti-oxydation additives. These various effects have beaten the "old demon heat" cycle. The heat cycle used to be that it was pretty hot to start with, the pump wore a little bit, it slipped more, it generated more heat. When the oil got hotter, it got thinner, as it got thinner, it slipped more, and very, very quickly this lead to pump failures.

So there we are today. We've got some pretty good systems and these systems are now transmitting, quite frequently, 100% of the engine horsepower. You could say the whole machine is a prime mover driving hydraulic pumps, and all of the power is transmitted to the work place by the hydraulic pipes.

Now, the pressures have galloped during this 20 year period of the 1970's-1980's, and in fact all of the machines that you see around now would be working at pressures of 5,000-6,000 psi. This has given rise to a totally new scenario when it comes to the diagnosing of the machine in the field. What we like to think is that diagnosis now takes place before failure.

I am proposing here that there are two key things to remember. I call them the "O - N" instruction. "O and N" means in diagnosis, observe and note. That is the main task that your machine operator has to be taught. Observe and note.

It can also be taken as meaning "Orl or Nothing". Machine owners have to decide, do they want to know all about the hydraulic system or nothing? Now the old motto says "a little knowledge is a dangerous thing". So the hydraulics people, like ourselves, are recommending you might as well know nothing, because that stops you from fiddling.

The "Observe" and "Note" as being the instruction which you give to the operator, gives rise to a very much better method of diagnosis and service than we've ever had before.

It gives rise to the possibility of what we call the two man team, where the operator in the field knows nothing, but he observes and notes, and the expert who know's, hopefully, everything, he is somewhere else, and he applies his knowledge, combining it with the skill of the operator, to come out with a very effective service tool.

Now I am going to let Kevin describe to you in more detail how this two-man team operates and how the actual service is done.

Kevin Daly: Thank you Wynne. As Wynne has commented already, the operator that's not too sure what he's looking at when he sees the sophisticated hydraulics on his log skidder, or hydrostatic drive, it becomes quite a nightmare. Probably also to the owner, due to the fact that it's broken down. Hence, if you can get the good old mobile phones, you can do a lot with them. You can call up specialists, whether it's hydraulics or some other industry. It's a lot easier to talk to you people while the machine is being operated. "The fact, does it do this? or does it do that?" In that way you get a real good feeling as to what has possibly gone wrong. Because when it does go wrong we've all got problems. One, yourself, your productivity has been lost. Down time is enormous really, irrespective of how much that machine's worth, because if you're working it, it's earning a dollar.

THE PRESENT

As Wynne has mentioned about in the 1950's with the dirt and grime that was put into the systems then, it still appears today even in new equipment, good equipment, possibly through the lack of knowledge of people manufacturing. No disrespect to any individual, it's just something that we all learn the hard way. But if we can all take time out and point out to our younger engineers or younger designers, to watch out for this or watch out for that, then it's going to be great.

Now the pressures are increasing in hydrostatic drives. We're getting up to 6,500 psi that we're reading on a gauge. Sometimes your spike pressures have to be monitored by electronic transducers since they could be 10,000 psi between a forward and reverse motion, it could even be more. To have that equipment peaking at that pressure, we've got to have a lot better filtration. Now, 10 micron has been commented.Ten micron nominal will let pieces 25 micron through the filter membrane. Remembering in fact that the naked eye can only see between 50 and 60 micron at the best of times, so you have two types of contamination here. You have chip contamination which is that big we can physically see it and it's that big it won't go in between the tight tolerances, or we can have the fine sediment, better known as silt control. That is what kills your system, what we can't see. I'll just touch on that a bit later.

The high quality oils required (as will be spoken about later) is very, very important, because what was used in the past at 1,500-2,000 psi certainly won't stand up to 6,000 psi. It just breaks down, and you've got to have your right blends, hence the tolerances.

In the past, if you had a suction screen and your machine wasn't working right, you pull it out, you can't see through it, you wash it and put it back in and it works. You're a winner. But today, the filters that are getting down to six micron absolute, are a one way trip. You throw them out and put another one in. You're doing the machine justice, and also in the long term in your own pocket, because if the filter membrane clogs up, the by-pass opens, you've got the raw oil going through unfiltered, so hence you're defeating the purpose. And unless the filter's got an indicator, you'll never know whether the by-pass is actually opened or closed.

DIAGNOSTICS

So, if we've got all that stuff sussed out we still have a diagnosing problem. The best way I can relate it to your operators or yourselves, is use it like a human body. If we are all feeling a little bit down and out, we all head off to the doctor for a blood sample. Do the same with the hydraulics. You draw out say 100-200cc. Make sure it's in an absolutely clean container, and when I say clean, that's not one you've had a drink of Coke out of and tipped it out and washed it out with petrol. We want it cleaner than that to do justice, because these systems have got to be ultra-clean.

The oil sample can be taken to two or three different places. More than likely the most appropriate is the oil company that is supplying your lubricants. They can send away and do an oil analysis. Just a

comment on that (I hope I don't get shot down) when you get a report back, its in parts per million and that's weight. If it's possible get something that can specify what kind of contamination you have in that oil, whether it's bronze, bright metal (being steel), plastics from seals, wood chip, sand,it's all there. And we're talking things down to 10-15 microns. Like I said before, we can't see it and that's what it really comes down to, the nitty gritties.

There are other places where we can have oil samples done, and that is through a "patch test" they call it, where you have to look through a microscope and you have a particle contamination that's where you actually see it. Whereas the oil companies can also do a fluid analysis to determine whether you have a solvent or water contamination or you are failing in some of your package deals where your wear additive, oxidation, shear etc. all that's starting to break down.

So once we've done a blood sample of our system, and we can analyse where some of these bronze parts or steel parts are coming from, we get a better idea of what's wearing. So, just like the doctor does, you can rectify the symptom and probably prolong life. However, if we don't, just like the humans, when it's failed you put it in a box, bury it, and start again. Because the simple fact is, if your machine is dead, we don't know what caused the failure.

In a hydrostatic drive, for example (most of you have probably seen them in logging) the same oil flows from the pump to the motor and back to the pump. If you ever get contamination or damage in one, it feeds the other, and brings it back. So we only assume that's where the failure started. When it's dead all we can say is: "Well look, all we can do is put the same gear back in, and start again".

By doing that we're sort of helping you out long term. However, I am well aware that it only breaks down when it's working, and that's the whole unfortunate thing about it. We don't have time to do it properly.

So therefore we need to have symptom analysis before it fails. Where we can possibly repair it in the field if it's a minor thing, or we have a discussion and see if it's viable to bring it back into a central workshop because it could be a two, three day job. If it's say a three day job (which I've experienced sometimes) you have a parts problem and you've got to remember some of the sophisticated gear that we've seen, no one in New Zealand can afford to put complete units on the shelf and wait for you to break down. Hence, we rely on airlines to freight it in from the country of origin, from the manufacturer. When you have to have your machine down two or three days or weeks you've got big problems. You can't sort of really subcontract the opposition into finishing your contract. That's just not on. So, if we can repair it before it fails, then we've got to be winning.

Your hydraulics people I personally believe are an asset to you, a bit like your accountant, and your solicitor. When you have a problem you use them. Don't abuse us, because we don't like being taken for a ride. But if you have a good liaison with someone and he's prepared to help you, he's worth a million dollars to you. Because, like I said with your accountant, he helps you out with your financial problems, the same with your solicitor, and if you can work with these people it's fantastic.

So again I stress, try and take an oil sample while it's starting to falter. Your driver knows what's happening. I know we have a tendency of forgetting what our driver says because he's always complaining, we're all guilty of that, but it doesn't really cost too much time to take an oil sample. If you're failing and you're only getting 70% traction drive etc. that's where you start. When you get your report, talk to someone about it, whether it's your oil company or somebody that does your regular maintenance. Be satisfied with what the end conclusion is, that is what you're really looking at, and then look at what the repair costs are. In the meantime your machine has got to be producing. That's what we've got at the moment.

THE FUTURE

Hydraulics in the future. Well, we don't really know where we are going, because really we the "hands on" people have no dictation as to what you're going to buy. It's the overseas manufacturers and suppliers, as we've seen this morning on some of the harvesters in the timber industry, the people that are designing them are the ones that are going to dictate what's in the future. Things get smaller, put in more power, because the power to weight ratio is very important as discussed earlier this morning about fuel costs. It all gets down to that.

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And now I'd like to hand back to Wynne in the respect that he's travelled the world a bit. He's seen what's in some of these hydraulics shows and seminars, not unlike what's happening here today. What's probably being produced today we will see in five, ten years time, and probably we'll be repairing it in 20 years time, I hope.

Wynne Cranston : Thanks Kevin. I would just like to deal with two aspects of what we've been covering. Earlier today, remarks were made concerning the changing level of skills out in the work place. We have to remind you that the two-man team that we were talking about overcomes the problems that you enunciated. The two-man team if you use the "O" and "N" (that is the "Observe and Note") gives rise to a scenario a bit like this :

> This did happen to me slightly differently.....I'm driving a new machine that's got hydraulics all over it and it's got a warning light. I was zapping up the hill and turning to the right, the warning light started to beep. So I thought that's tricky. I took off my shoe phone, and tickled my head and whilst still using the machine I called Kevin. And I said to Kevin: "When I go up hill at high revs and turn to the right the warning light beeps. It says 'stop', should I stop?"

He said to me : "If the warning light goes out again, you could continue working". I asked: "What shall I do next?", and he said : "Well, try going uphill somewhere straight ahead". There was a hill ahead, so up I went at the same number of revs. The warning light didn't come on. Kevin said to me over the phone : "You better try turning right and then turning left".

So I turned right and then turned left. "The warning light came on both times" I said. "Okay", he says, "I'm looking at the circuit of your machine and it tells me that when you're steering, a priority valve gives first priority to the steering. You're probably diminishing the pressure in the remainder of the circuit. You're losing pressure somewhere".

Okay, so I drove on a bit further and I said : "What should I do?" He said: "Loss of pressure could be either something malfunctioning in the pump, or low oil level". "Ah, I had an oil leak last week and I got it fixed". So he said : "Well did the man who fixed it top up the oil level?"

I said: "I don't know". He said: "You'd better shut down and have a look". So I brought the machine to rest and looked at the oil level. I went back to my phone: "It looks okay to me". "Ah, but", he says, "It says here in the Parts Book that when you check the oil level you have got to put the machine into a condition where all the cylinders are extended, that is, all the piston rods have gone out and the oil level has gone down to a minimum ". So I did that and I went back to check the oil level indicator and there it was it was, below the minimum mark.

So Kevin says to me : "You'd better put some oil in". And I say to him : "What sort of oil". He says : "Go down to your friendly Caltex dealer!". So I did that, and behold the warning light didn't blink any more.

But of course, there are two little snippets I must tell you here. Warning lights are not new, they've been around for a long, long time. In a British magazine of motoring humour, the author was describing the instruments on the dashboard. He said: "One of these is called the water temperature gauge. This is a little device, which tells you how hot the water is in the engine. If it always points to boiling, then you need either a new fan belt, a new radiator, a new engine, or a new little device!".

And of course I must comment from there, you must be careful translating that one, because if you read in the paper a few days ago, the airline pilot and the co-pilot, they were landing their aircraft, and the little red light came on and they said to each other: "Say we need a new little red light, don't we?". And they continued to land the aircraft and later on they discovered that the little red light was telling them they had forgotten to put the undercarriage down!

So every time a little red light malfunctions, first make sure that the warning is taken notice of.

CONCLUSION

As we look into our crystal ball, the most important thing that we can tell you about your hydraulic system in the future is it will almost certainly be totally controlled by electronics. Some of you may not want to hear that and when we come to the forum this is a subject that I hope that you will put plenty of opinions into. The reason we say it will be controlled by electronics is, that that has been the trend. The original machine was controlled for direction or speed, or feed, or power by the operator. He had his hand on the lever, and he pulled it, and he pushed it, and the machine responded as best it could.

Designers realised that if you put automatic feed control, automatic speed control, automatic safety over-rides, automatic repetitive sequences, then you can get more machine performance. Sure, you might say: "We used to think the operator could do the best". But I can quote you one that you've seen this morning: the saw that cuts off the tree. Now you've all seen the chainsaw operator. He's pretty good, but if you set up a hydraulic cut-off saw with hydraulic feed, feeding the saw through the log, and a sensing device which measures the load on the hydraulic motor that drives the saw, then that cut-off device will feed the saw through the log at such a feed rate, that the load on the saw itself remains constant. Many people have carried out tests, and almost without exception, if you do that you'll get through the log, 20% faster than any human operator can achieve.

The other advantages of the electronics control of the hydraulics is that it is light in weight, perfectly safe and we are going to state it is relatively reliable.

But of course, here is the curly question. The thing against the electronic system is..."What do you do when it seems to go wrong? What do you do when the red light winks, and you're not sure if it's the red light that's at fault and you need a new little device, or maybe you need a whole new engine?".
Thank you.