

# L&T Earthmover News

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## Oil Analysis: The science of predicting component health

**I**n the earlier issue we had written about contamination in hydraulic system – its source, causes, effects and steps to contain. Regular oil analysis was suggested as a mean to look into the hydraulic system. In this edition, we shall elaborate on the methods to identify the extent of contaminants and what it means to the user.

An adage goes like this – Character of a person can easily be perceived with the company of friends he keeps. Smoker's clothes spread cigarette-smell like traces of drugs noticed in the blood of drug addict. A blood test reveals the state of health and based on which, medication or test is prescribed. The same holds good for machines as well – be it engines, transmissions, final drives or for that matter the entire hydraulic system. The lubricating oil, transmission oil or hydraulic oil narrate stories of the wear pattern taking place within the component and their health. Thus, if oil is tested, analyzed and studied, the condition of components can be monitored and the best life extracted.

Komatsu has elaborate oil and wear analysis (KOWA) programme in place that deals with the study of oil in various compartments of the machine.

Whenever sliding parts in a machine move, there will be wear. Wear means the loss of solid material due to the effects of friction of contacting surfaces. This is an absolutely normal phenomenon. The wear particles will get mixed with oil used for lubricating the system.

KOWA is a system of measuring the densities of these wear particles and how they change over a period of operation. The size of the wear particles is so small that they are not only invisible to the naked eye; they even pass through the filters and remain suspended in the system oil. Such oil, containing wear particles, when subjected to high temperatures, emits (or absorbs) light of a wavelength that is peculiar to a particular element. This property is used to optically analyze the density of metal particles in oil in terms of PPM (Parts per million). With KOWA, the measurement of the density of minute wear particles and the changes in their trend with time are plotted and used for estimating the extent of wear inside the component and taking preventive action. Inductively Coupled Plasma (ICP) Spectrometer is used to measure the wear particle density in oil.

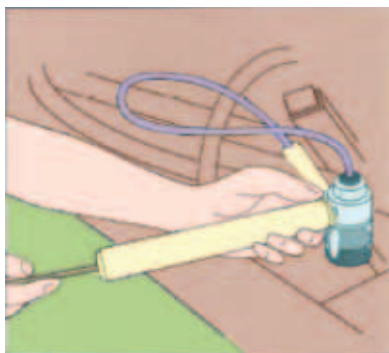
A proper oil analysis program involves the following steps:

- a. Sampling
- b. Analysis
- c. Interpretation of results and
- d. Corrective action

### Sampling

Correct sampling is the key to an effective oil analysis programme. Specific sampling pumps

and sampling kits are available for extracting oil samples.



*Oil Sampling Pump and Kit*

The sampling kits use sterilized plastic/ glass containers, which are free from dust and other particles. Oil sampling should be done when the oil is still warm, that is, right after the machine has stopped. Sampling should be done under similar conditions at all times to maintain uniformity. The sampling hose should be dipped around 50 mm into the oil and not touch the base, so that it does not suck sediments. Once a sample is taken, a check sheet should be filled giving inspection details like machine serial number, service meter reading, sampling date, hours run after oil change, hours after filter change, grade of oil and brand.

Oil sampling interval is a key factor in determining the wear pattern. For engine oil, sampling should be done every 250 hours or 500 hours, prior to oil change. However, after a major repair, take oil sample after ten hours of operation. Sampling interval should be reduced in case an abnormality is noticed in the previous result. For other hydraulic systems an interval of 250 hours for the first 1000 hours of operation and thereafter 500 hrs will give fairly good results. Sampling at around 50 hrs should be done after major repairs.

## Analysis

Normally an ICP analysis is carried out to analyze the wear density of seven key elements as in the table below.

O = Analyzed element

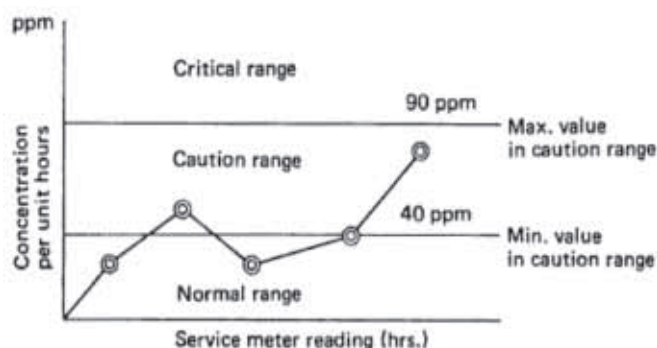
Element/ component	Fe Iron	Cu Copper	Cr Chrom- ium	Al Alumi- nium	Si Silicon	Pb Lead	Na Sodium
Engine	O	O	O	O	O	O	O
Power train	O	O	O	O	O	O	-
Final drive	O	O	O	O	O	O	-
Work Equipment	O	O	O	O	O	O	-

Other analysis like entry of water, fuel, anti-freeze can be done for engines. Entry of water can be checked in power train, final drive and work equipment.

The test result will provide concentration levels of these elements in PPM, which have to be plotted on a graph for each element, and the trend line studied to arrive at a conclusion.

## Interpretation of results

The results obtained should be plotted on a graph with service hours on the X axis and the wear concentration in PPM on the Y axis. To draw some conclusion, at least several test results need to be plotted. The trend line thus created will reveal the change in concentration and help in drawing inference. The following is a typical result plotted.



A standard value is provided to divide the concentration into normal, caution and critical range as shown. The standard value is indicated by the minimum and maximum value of the caution range. Corrective action is required, if the PPM goes in the abnormal range.

While interpreting results, some key points to be borne in mind are..

- When oil analysis is first used after initial commissioning of a machine, the initial wear has to be taken into account.
- Oil changes and service hours have a large influence in the concentration levels of elements. Simply put, the concentration level will be lower after oil change and thereafter, longer the service hour, higher will be the concentration.
- The standard values of evaluation are based on 250 hours of oil use on engines and 500 hours for other systems. For example, an analytical value of 20 PPM obtained for oil used for 1000 hours in the hydraulic circuit of work equipment. Since the unit hour for work equipment is 500 hours, the converted value for concentration can be obtained by

$$20 \text{ ppm} \times 500 (\text{unit hours}) /$$

$$1000 (\text{hours oil was used}) = 10 \text{ ppm}$$

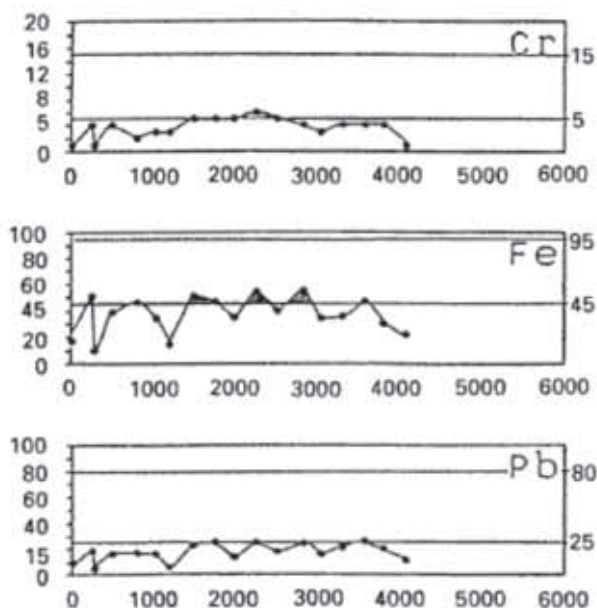
When oil is changed, wear elements still remain within the balance portion of the old oil. Hence, even if oil sampling is done immediately after oil replacement, the analysis value will not be 0.

Operation and maintenance manual provides inputs on the specified quantity and refill quantity of oil in a system. If the specified hydraulic system capacity is 230 litres and the refill capacity is 170 litres then the oil change ratio is  $170/230 \times 100 = 74\%$ .

If the sampling analysis for Fe just before oil replacement is 20 ppm then immediately after oil replacement the Fe ppm can be calculated as

$$20(1-74/100) = 5.2 \text{ ppm}$$

On getting the results, individual graphs for each element can be obtained by plotting the analysis results over long service hours. This data when documented machine-wise, describes how normal wear in components have happened over a period of time.



The following table provides clues for the probable components whose excessive wear can result in an abnormal rise in the concentration.

O= Rapid increase in concentration X= Concentration may become higher

Component	Highly concentrated elements							Assumed location of defect
Engine	Fe	Cu	Cr	Al	Si	Pb	Na	
	O							Liner, crankshaft, timing gear, camshaft, rocker arm, FCD pistons
		O				X		Timing gear thrust bearing, bushing for timing gear, pin, oil pump, camshaft and bearing metal from crankshaft
		O					O	Water leaks from oil cooler
				O				Crankshaft thrust bearing, turbo thrust bearing, Aluminum piston
			O					Piston rings
Final drive	O		X					Gear Bearing
		O						Thrust bearing material
	O	O	X	O				Floating seal
Work Equipment	O							Cylinder wall, gear pump
		O						Cylinder rod
				O				Pump body
		O						Pump side plate, plain bearing, retarder brake disc.



Similar judgment table is available for all systems that can guide in analyzing KOWA results.

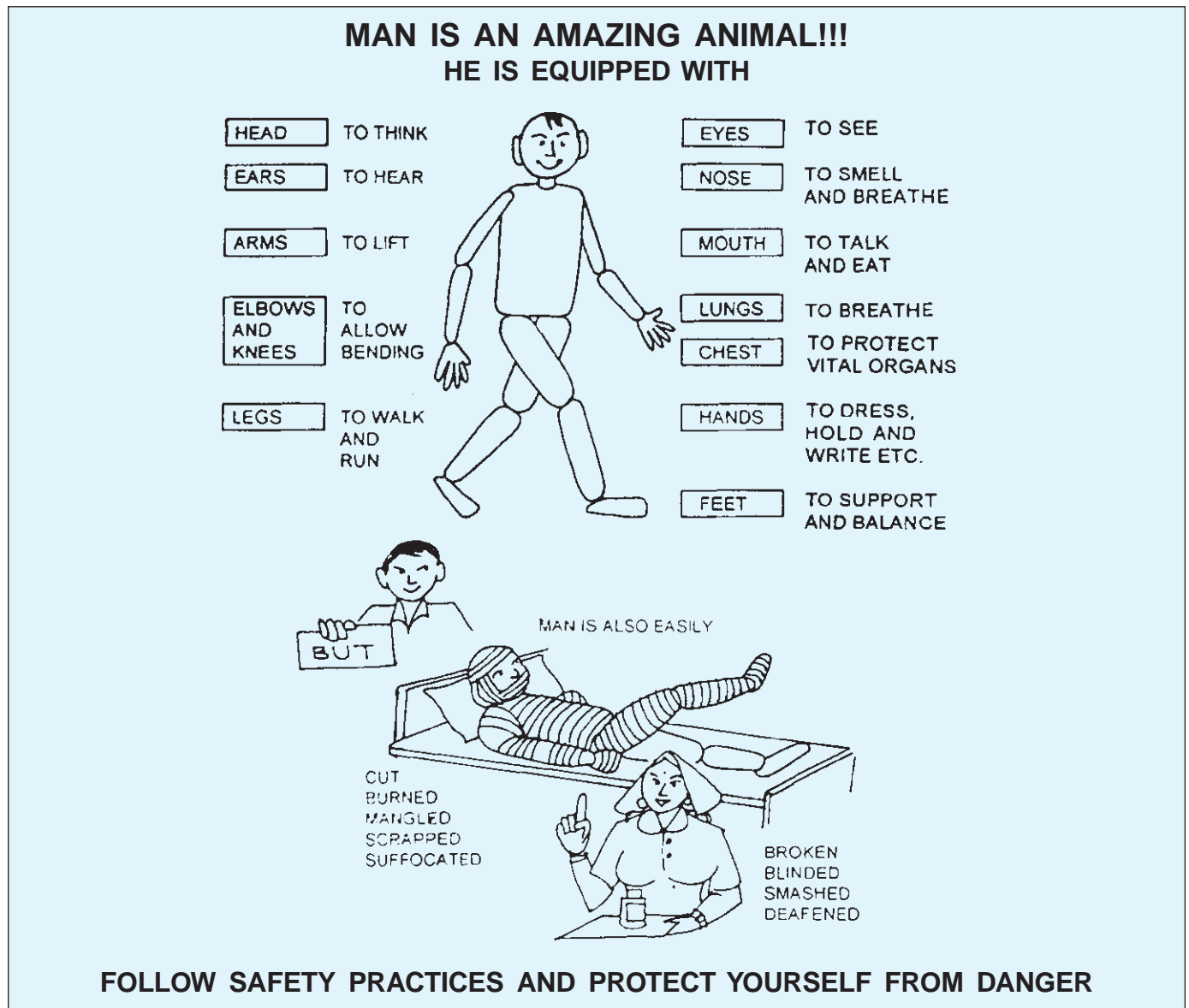
Apart from wear metal analysis, KOWA programme can also be used to check water, fuel and anti-freeze mixed with lubricating oil. Water in oil will significantly disturb the properties of oil, can emulsify oil, give rise to loss of lubricity, give rise to rust formation and adversely affect engines and hydraulic systems. Water in oil, is checked by putting one or two drops of oil sample on a hot plate heated to around 150°C and observing the formation of steam bubbles formed. The degree of bubbling can be compared with that of known new oil. Conclusion and corrective action can be taken accordingly.

Measuring the reduction in flashpoint of the specimen oil identifies fuel in oil. Standard flashpoint of new oil is available and the reduction can be compared to determine the percentage of fuel in oil.

KOWA is thus a very scientific method of conditioning monitoring and looking into the health of major machine systems. In the present context when the cost of machine is high and higher is the cost of down time, KOWA becomes a must for fleet management. The benefits can be summed as

- Reduction in unscheduled downtime
- Effective maintenance scheduling
- Improved equipment reliability
- Reduction in maintenance costs
- Maximization of oil change out intervals
- Reduction in machine power consumption

*The forthcoming issue will definitely cover something equally informative and interesting, so keep track of the Earthmover News.*



## Maintenance of Machine is the Key at Lakshmi Cements Limited

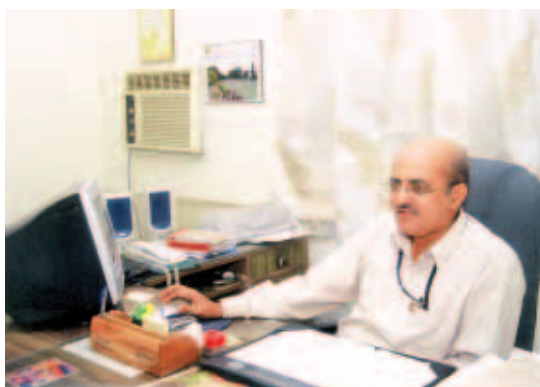
**J**K Lakshmi Cements Ltd is situated at Jayakaypuram in Udaipur, Rajasthan. The company was incorporated in 1980. It transited from its original name of 'Straw Products Limited' (then owned by the Singhania), to the fold of J.K. Corporation in 1997. The transition led to a cultural change in the organizational set-up. New technology was introduced for better production and the system was revamped.

In the later years, on the basis of market feedback, the company realized the need to strongly establish its brand image in the market. The Lakshmi Cement brand needed no introduction in the northern market. It was incorporated along with the corporate brand and emerged as 'JK Lakshmi Cements Ltd.'

Commenting on the emergence of the new brand image, Mr. V.K. Mitra, Vice-President (Mines), states, "Lakshmi Cement brand was so strongly imprinted in the minds of the people that we felt the need to combine it with the JK brand. It is now easy for the public to remember that the brand is coming from the house of JKs."

Mr. V.K. Mitra is a graduate (1970 batch) from the Indian School of Mines, Dhanbad and completed his post graduation in 1973. He had an opportunity to work in Bharat Gold Mines Limited and then with Cement Corporation of India Limited in different capacities. During his tenure at Cement Corporation of India, Mr. Mitra came across L&T hydraulic excavators, which he introduced in Lakshmi Cements in 1992.

During his long tenure at Lakshmi Cements, Mr. Mitra has enjoyed the freedom of introducing many innovative ideas. For example, he introduced a software system to track the life of machine components at any given time. It was the joint effort by a team comprising a mining engineer along with two software engineers. The mining engineer could spell out the real requirement and ask for software solutions. This system also computes the cost of repair and prepares the maintenance schedule. It also does fault analysis and indicates the machine's efficiency level.



Mr. V.K. Mitra

Mr. Ganpat Singh Rajawat, Chief Executive (Works), stresses that the quality of the product is the key to success. Besides product quality, Mr. Rajawat is also concerned about the social responsibility of the organization. "It is all round development that leads to prosperity", he claims. "Those were the days when this area was untouched by civilization and the people still used to

depend on bows and arrows. People are good, only they need a little empathy. Now there are no problems. There is no boundary wall to our factory at JK Lakshmi Cements." He adds proudly, "Our mission was to create job opportunities for the locals from the inception. We have not lost even a single man-hour due to labour unrest in the last 16 years."

Some of the welfare activities conducted by the company are village adoption for complete development, distribution of school uniforms, providing furniture, constructing school building, conducting evening classes for the aged and computer familiarization programmes (designed by TCS).

Under the development programme, rain water harvesting resulted in increased ground water level, earthen dams were built at villages like Rampura, hand pumps were donated to schools. Under the laudable 'Naya Savera' programme in association with Population Foundation of India, we organised 'Health Melas' creating awareness on health related matters among the villagers. "We have ten dedicated villages for this programme and every week, on rotation, our team visits these villages. The response is tremendous. We were able to treat over 10,000 people in the last three years and our Ladies Club organizes mobile surgical camps and educates them on post-care at the hospital and at home. On the education front, we started a school with CBSE syllabus, initially for the employees' children; but now it is extended to the local students. It has a strength of 750, and goes up to 12th Standard."

The company is organising Mines Safety Week every year at different locations within Rajasthan, and winning prizes regularly. Afforestation is an ongoing process and the company has earned the ISO and OHSAS certificates. The Company has also won "3 Leaves





Mr. Manmohan Singh

Award” from Centre of Science & Environment and is the only plant in Rajasthan to have won this coveted award for green rating.

Mr. Ganpat Singh is a mechanical engineer (1968 batch) from BITS Pilani. After working with Jaipur

Udyog and Diamond Cement, he joined JK Cements in 1996 and worked in the capacity of Chief Executive (Works). Though his hobby is reading English novels, from 1972-73 onwards he started devoting more time to spiritual thinking, preferring to read the Bhagavad Gita. Mr. Singh feels that the essence of the Gita is of great help in his day-to-day activities. During vacation, Mr. Singh prefers to travel a lot and enjoy the natural beauty.

Mr. Singh states, “Brand L&T supported with reliable service reputation, is the key to the dominance for L&T supplied excavators at Jaykaypuram”.

L&T’s association with JK Lakshmi Cements in relation to construction equipment dates back to 1992-93, when they introduced the first L&T 300 hydraulic excavator. The entry was achieved against stiff international competition. “The popularity gained by the machine in other mines was its edge over others,” recalls Mr. Mitra. Satiating their expectations, more machines found their way to JK Lakshmi Cements. With an ambitious expansion programme in the offing, six L&T 300 hydraulic excavators came to JK Lakshmi Cement within a span of two to three years (1992-94). Some of these machines have clocked 25,000 to 30,000 hours. Mr. Manmohan Singh, Senior Manager (Diesel), says, “These machines are workhorses” and adds, “we have adapted certain onsite modifications to suit the working conditions, which resulted in much greater fuel efficiency.”

Mr. Manmohan Singh completed his engineering in 1992 in the mechanical stream at Jodhpur. Prior to JK Lakshmi Cements, Mr. Manmohan Singh worked for D.K. Trivedi & Sons for

two years and gained hands-on experience on commissioning L&T 300 hydraulic excavators. He joined Lakshmi Cements in 1994 as a mechanical engineer. With his hard work and dedication, he has now been

assigned the responsibility of heading the unit. Ever willing to take additional responsibility, Mr. Singh believes in taking on challenges and getting satisfaction after completion of the job.

“The secret of getting the maximum out of a machine is ‘its maintenance’. There should not be any compromise on regular maintenance. We maintain the operator log book and strictly follow that. With all the analysis available, we follow the PM clinic for the machines. To avoid any breakdown for want of spare parts, we do regular inventory check and plan the requirements. The total planning is done at the beginning of the year. Any servicing that is done will be as per OEM’s specifications. This is the company policy,” says Mr. Singh.

“Machine operators are ITI-qualified and trained by L&T. Hence, no abuse of the machine,” Mr. Singh asserts. “L&T Service is true to its saying ‘in service lies success’. Though we carry out on the spot maintenance, we always refer the matter to L&T for further action. L&T’s helpfulness and openness make our job simpler,” concludes Mr. Singh.



Mr. Ganpat Singh Rajawat



## INFRATECH 2006

All India Manufacturers' Organisation – Chennai unit, a leading Chamber of Commerce in India for the last 60 years organized the 'International Expo cum Seminar on Surface Transportation' (INFRATECH-2006). The theme of the event was "Opportunities and Technology." The programme was at I.I.T. campus, Chennai from 17<sup>th</sup> to 19<sup>th</sup> August 2006.

L&T's Engineering, Construction & Contracts Division (ECC) was one of the co-sponsors of the event. The topics covered during the session were road development in India, modern construction equipment, availability, usage, advantages, besides case studies and discussions with the stalwarts of the industry on private sector participation in infrastructure development support.

L&T's Construction & Mining Equipment Business Unit put up an indoor stall and displayed relevant equipment photographs.



## SUMINFRA 2006



*Mr. J.P. Nayak, President & Member of the Board, L&T seen at the 'SUMINFRA' stall*

Confederation of Indian Industry (Southern Region) organized the fourth annual event 'SUMINFRA-2006' at Chennai on 3<sup>rd</sup> and 4<sup>th</sup> August 2006. The theme of the conference was 'A summit on sustainable private, public partnerships in infrastructure'. The focus of the event was

on Roads, Ports, Airports & Seaports, Tourism Infrastructure, besides regular coverage on 'Urban Competence, Rural Competence and State Integrated Infrastructure Promotion'.

During the summit, the organizers provided an opportunity for the participants to display their capabilities through photographic images. Larsen & Toubro Limited co-sponsored the event. The delegates had an opportunity to interact with the experts from the industry.



*Glimpses of photographic display*



## L&T Komatsu PC300LC-7 handing over Ceremony

**S**C Thakur & Brothers, an ISO 9001-2000 Company, at Panvel Mumbai, is known for construction of roads, highways, earthwork and irrigation tanks. They recently purchased an L&T Komatsu PC300LC-7 Hydraulic Excavator. This is the first L&T-Komatsu PC 300LC-7 Hydraulic Excavator in Raigad belt and it is being used for soil excavation at Padeghar site, Panvel.

Mr. Ramseth Thakur's association with L&T is a long-standing one. He purchased the first L&T 90 II machine in 1987, followed by L&T 170 in 1989, and a fleet of four L&T-Komatsu PC 200-6 in 2001.

Mr. Ramseth Thakur (Ex MP) is a renowned personality in the Panvel belt. He is actively involved in social work for the underprivileged, development work in education and providing basic amenities in and around Panvel and Raigad regions.



*Photograph shows Mr. Ramseth Thakur elder son of Mr. Prashant Thakur (Managing Partner) and Mr. Paresh Thakur (Managing Partner) receiving the machine key*

## Machine Demonstration

**L**&T's Jaipur team conducted road shows of Komatsu PC 130-7 Hydraulic Excavator. The main focus



was on the hiring belt - sand stone mining. The machine was transported through various locations and the road shows were conducted in Sarmathura, district Dholpur and at Karauli.

## Earthmoving Machinery Owners' Association

**E**arthmoving Machinery Owners' Association, Kolhapur organized their fourth Annual General Meeting in July 2006 at Kolhapur. To address the captive audience, L&T's Construction Equipment Business team at Pune along with our Dealer, Aryan Earthmovers, put up a stall at the venue. L&T made a presentation to the Association on the equipments offered.





## New Showroom of Dealer



In view of the increasing population of L&T supplied construction equipment around Jamnagar, L&T's dealer V.B. Techno Enterprises has opened a branch at Sikka Patia, to provide quick service to the valued customers.

## Distributors' Meet at Singapore

L&T's Construction & Mining Equipment Business Unit is the authorized distributor of Komatsu Asia & Pacific Pte Ltd. (KAP), Singapore (which is fully owned by Komatsu Limited). L&T distributes in India construction and mining equipment manufactured by Komatsu's plants worldwide and also provides after-sales parts and service support for these equipment.

KAP Singapore had organized their second Regional Distributors Conference for spare parts on 13<sup>th</sup> and 14<sup>th</sup> July 2006 at Singapore. During the conference, there was a discussion on the potential of individual distributor, challenges being faced, strategies adopted to overcome the hurdles, etc.

KAP emphasized on the benefits of other distributor-fraternity and shared the strategies adopted by the successful distributors.

It also recognised the achievement of L&T as a distributor of spare parts during 2005.

Mr. A.K. Garg, Jt. Gen. Manager - Construction Equipment Business along with Mr. K.A. Sravan Kumar - Sales Development Manager - Spare Parts, Larsen & Toubro Limited attended the meet.

In recognition of L&T's Filter Sales Promotional Plans, strategies adopted and the growth achieved, Komatsu applauded L&T in the forum with "Best Performance Award 2005" for filter parts sales. Mr. Hisashi Miyazaki, President, KAP presented the award.



(R to L) Mr. A.K. Garg, and Mr. K.A. Sravan Kumar, holding the plaque. Mr. Hisashi Miyazaki, is also seen



# “Cure to Care” Health Monitoring System on Mining Equipment

## Introduction

Effective asset management is imperative in any mining operation to optimise value for money. Equipment durability and life can be maximised by adopting efficient predictive and preventive maintenance practices. This necessitates carrying out constant assessment of health of the equipment. Usage of on-board facilities once employed on this mining equipment can provide means to monitor non-stop, the essential parameters. Today many construction and mining equipment manufacturers offer such monitoring systems in India for assessing the health of the equipment.

End-users are offered value-added services through “utilisation of information technology” and “realisation of products and services provision on a one-to-one basis”. Mine-Machine management system utilising the Global Positioning System, or GPS, is gaining wide acceptance in mines all over the world. And in the future manufacturers will concentrate more on what they can do for end-users with the information technology.

By adopting monitoring systems as a standard feature, these equipment are easily manageable in terms of optimizing their true value, as the system apart from constant capturing of health parameters actually suggests timely corrective action.

This paper aims at highlighting the features of such monitoring systems to strengthen asset management capabilities vis-à-vis those achieved through conventional maintenance practices.

## What is the “Cure to Care” Equipment Health Monitoring System?

“Cure to Care” Equipment Health Monitoring System essentially makes use of information technology tools and mechatronics by adopting numerous sensors, processors, exclusive software etc., for capturing and analysing required data. System provides vital machine information - fault information, production information, fuel consump-

tion, trends of the data received and the ability to predict service needs. Prime focus is to affect shift from Cure to Care proactive action - i.e., change fire fighting to proactive action.

## Advantages

Some of the main advantages of the “Cure to Care” system are highlighted below:

- 1 Remote Monitoring and recommendations
  - Common use globally. End-user invests time & resources on acting rather on administration.
  - Borderless gathering/sharing of knowledge. Availability of expert diagnosis of analysis for the equipment.
  - Expert recommendations direct from OEM database.
- 2 Forecasts failure before they occur
  - Timely advice on poor maintenance (Water, Oil level low etc.).
  - Takes the guesswork out of problem identification and correction.
- 3 Finds errors due to machine abuse
  - Proactive action against abuse to reduce repair cost (Overrun, Overload, lack of warm-up etc.).

## Capturing equipment health:

The very first step is to establish a path for receiving information from the equipment, processing the same and interpreting the results. Various sensors pre installed on the equipment provide feedback to the controller on the equipment. Information thus available from controller is transmitted via satellite (alternatively using internet)

to the server at resource center. For downloading of data from machine controller, it is not at all essential to stop the equipment operation. This is achieved by establishing wireless arrangement on the equipment and wireless network enabled computer located remotely at suitable range from the equipment data transmitter. Resource center



(L to R) Mr. P.R. Naik, Head, Product Support Department receiving the memento from Dr. P.S. Mukherjee, ISM, Dhanbad



processes the data in detail. Information thus processed may be checked anywhere in the globe using Internet. Getting instant results of basic condition monitoring at site level is also feasible. Apart from this, a preventive maintenance exercise may be carried out on the machine to evaluate the present condition.

#### **System Capabilities:**

Depending on the type of health monitoring system provided on the equipment, numerous critical conditions may be monitored and expert recommendations obtained for corrective action. Some of the capabilities that health-monitoring system offers are:

- Operating parameters monitoring
- Production, Fuel consumption & Load changes monitoring
- Maintenance parameters monitoring
- Caution & critical alarms for timely action
- PM clinic exercise simulation & instant test results
- Component overhaul intervals estimation advice

#### **Planned Maintenance through monitoring systems:**

The system provides means to monitor and caution about day-to-day maintenance requirements such as

the oil change intervals and filter replacement intervals. Integration of data with hours operated and date range also results in preparation of maintenance plan on technical inputs. This also eliminates the need of keeping manual record of key maintenance parameters thereby enabling better and planned maintenance.

#### **Monitoring machine condition:**

Key parameters of the entire equipment are monitored. Be it a engine or power train component or hydraulic system, – it is easy to monitor all the conditions for all the components in real time environment with great precision and without missing out on any important condition.

#### **Monitoring to predict Component Overhaul intervals:**

Estimation of component overhaul intervals is possible through the system. It can be achieved by mapping of various parameters like engine load factor, transmission shift frequency, oil wear analysis etc.

#### **PM-Clinic through Monitoring System:**

Preventive Maintenance Clinic test on Equipment employing Health Monitoring System at any given point of time is a very easy affair. Measurement and reporting accuracy are greatly optimized using the system.

Table - Comparison of PM Clinic exercise with monitoring system over conventional methods

	Conventional Methods	Health Monitoring System Methods	Remarks
Average time taken	2 hours	10 minutes	Highly efficient
Tools & resources	Special external kits	On board resources	No special tools required
Skills	Skilled manpower must	No specific skills required	Accurate results
Capturing of data	Manually filled formats	On board display/ printouts	Ease in capturing/analysis
Recommendation	Based on experience	Based on technical data	Reliable & proactive

#### **Trend mapping using the system:**

Apart from generating trend data/graphs for key parameters, programmes like Oil wear analysis and undercarriage wear analysis can be integrated with the monitoring system to capture and evaluate the data with predefined figures to generate recommendation reports for possible corrective action required and also to inference the components life left. With accurate mapping of trend and parameters found, timely parts planning is feasible.

#### **Limitations of Health Monitoring System:**

Despite several advantages of condition monitoring practices through health monitoring systems, there are some limitations as well:

- Erratic system component – for example, a faulty sensor will trigger a false alarm. At times, detailed manual inspection/analysis may be required.
- Link failure or unavailability of IT resources like Satellite, Internet connection etc. may effect the full utilization of health monitoring system.

- Permanent health monitoring will generate lot of data. Some discipline and skills are warranted to draw inference and implement system derived reports.

### Conclusion:

Equipment health monitoring system is an effective condition monitoring and equipment maintenance management tool provided on critical mining equipment, with added advantage of access to OEM resources and recommendations. A small investment to make best use of such health systems and implementation of corrective actions suggested/derived will cut the overall

cost of managing the assets. In future, availability and usage of such systems shall be enhanced further enabling end-users to reap the benefits of revolutionary technologies.

The system is found to be an invaluable assessment tool for ensuring basic to advance monitoring. Its ability to help in analysis, testing, diagnosis, surveillance and control is unparalleled. Extensive use of the system on earthmoving and construction machinery has had a significant impact on better maintenance practices, greater availability, reduced costs and resource utilization.

## Customer Meet at Barhi

**B**arhi, a bustling township at the intersection of G.T. Road (NH-2) and Ranchi - Patna Highway (NH-33) in Jharkhand has a circumferential span of 25 Km. radius only. However, today Barhi has emerged as the most powerful outsourcing hub of skilled operators for excavators, dozers and motor graders; feeding construction and mining work all over the country. Since 1990 many motivated operators formed micro co-operatives among themselves called "COMMITTEE" comprising of 6-7 partners and purchased used dozers, for hiring out to contractors. The profit thus accrued was shared among the partners proportionate to their investments. It has, indeed, paved the way for successful sustainability with low operating cost in maintaining equipment. The model had gained instant acceptability in the area and the operators started buying excavators and deploying them mostly in Central,

Northern and Eastern parts of India. A small initiative taken earlier has culminated into a revolution today with a pool of about 300 units of excavators to cater to hirer segment.

A customer meet was held at Barhi in this highly promising and dynamic marketplace to reinforce L&T's position as the leaders in supplying quality products and services. The venue for the occasion had an impressive photographic display of our complete product range and support capabilities with a live demonstration of PC200-6 and audio visual presentation on PC300LC-7.

The customer meet generated enormous interest and goodwill in the market and about 350 personnel representing about 100 customers attended the show.



*Audiovisual Presentation in progress*



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