L&T Earthmover News

Vol. 17, No. 2 April-June 2005

Electricals & Mechatronics in Earthmoving machines

Electrical systems have always been an integral part of any earthmoving machine. Its application was predominantly limited to engine self starting, horn and operation of other safety devices. However, today electricals and electronic control of mechanical systems (MECHATRONICS) play a much greater role in power, control and monitoring system of any earthmoving machine.

We shall unfold the various aspects of electrical and mechatronic features used on earthmoving machines with emphasis on the understanding of the major components, the basic system followed, and the dos and don'ts to extract the maximum from the feature, without exceeding the safety limits. Understanding the battery, therefore, automatically comes first in the line.

Battery:

Battery is the electrical powerhouse on a machine and is responsible for starting the engine and responsible for supplying electrical power to all loads when the engine is not running. Once the engine starts, the alternator takes over the responsibility of power supply and also charges the battery, so that it is again fit for the next cranking.

The battery is technically known as the Lead Acid Battery due to its two main constituents: Lead as the electrodes (Terminals) and Acid (Dilute sulphuric acid) as the electrolyte.

A typical 12 Volts battery is made up of 6 cells, connected in series. Each cell produces 2 Volts (2.1 Volts to be specific), which adds up to 12 Volts across the positive and negative terminals.

A cell consists of +ve (positive) and – ve (negative) plates dipped in the electrolyte. The specific gravity of the electrolyte is around 1.260 when the battery is fully charged. The electrolyte used consists of a solution of

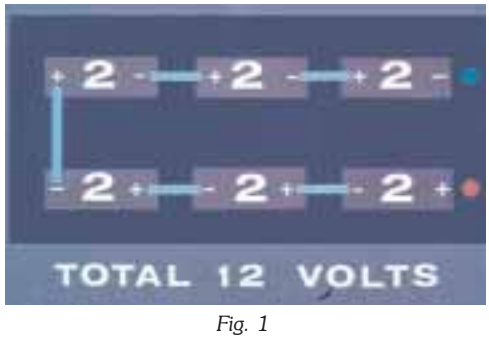


Fig. 1

Fig. 2

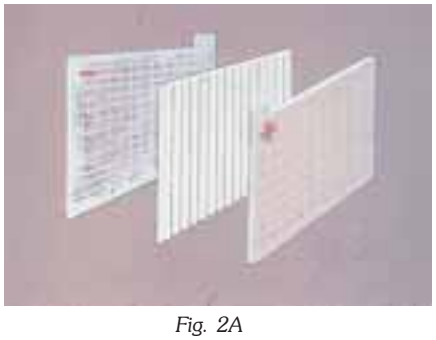


Fig. 2A

3 parts of commercial sulphuric acid of specific gravity 1.840 with 8 parts of distilled water. Pre-mixed electrolyte of specific gravity 1.280 is readily available in the market. The +ve plate is Lead peroxide PbO_2 while the -ve is pure or spongy lead (Pb).

The plates are electrically connected through the electrolyte, whereas porous separators physically separate them. (Fig 2 & 2A) There is always one –ve plate more than the number of +ve plates. Thus the total number of plates in a battery is always an odd number. When the external terminals are connected to a load, current flows from the +ve terminals to the –ve terminal. A reversible chemical reaction takes place during discharging when the battery delivers current to the load. At this time, sulphuric acid reacts with PbO_2 of the +ve terminal and converts it to lead sulphate ($PbSO_4$), while the electrolyte gets converted into water. The –ve plate too gets converted into lead sulphate. The electrolyte is about 39% acid and 6% water by weight in a fully charged battery whereas it is about 85% water and 15% acid when fully discharged. As electrolyte gets converted into water, its specific gravity reduces, and so does its reacting capability. When the specific gravity reduces to around 1.050, a battery is fully discharged; its terminal voltage will reduce to around 10 Volts and will no longer have the capacity to deliver current.

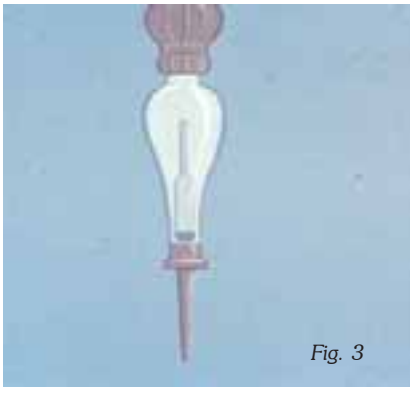


Fig. 3

Hence, from the user point of view, the terminal voltage and the specific gravity of the electrolyte are the two most important parameters to determine the health of a battery.

Specific gravity is measured by a commercially available hydrometer. The hydrometer directly measures the specific gravity, and not the % of charge left. (Fig 3)

The specific gravity can be taken directly from the markings on the float stem. While taking the readings, we usually do not refer to the decimal point. For instance, we say twelve sixty for 1.260 or twelve thirty for 1.230. The following table gives the readings and state of charge of a battery.

No.	Approximate Sp.Gravity	State of Charge
1	1.260–1.280	Fully Charged
2	1.230–1.260	¾ Charged
3	1.200–1.230	Half charged
4	1.170–1.200	¼ Charged
5	1.140–1.170	About run down
6	1.110–1.140	Discharged

Battery Rating:

Batteries are rated in terms of its current Ampere-Hour (Ah), at 20-h rating. A standard 20 hour discharge duration is considered. The product of current delivered and discharge duration becomes the rating of the battery. The battery used on PC200-6 has 100Ah rating. 100 = 20Hours X 5 amperes. Hence, a fully charged 100Ah battery can safely deliver 5 amperes current for 20 Hours; thereafter it gets fully discharged to the extent that it can be recharged again. Describing a battery by the number of plates does not give a true picture of the capacity, however, even today most of the field staff still use the no. of plate classification, with an understanding, that higher the number of plates, higher is the battery capacity.

Charging:

Normally the alternator on the machine is the best charging device, and for a properly maintained battery and electrical system, external bench charging may not be required during the entire battery life.

However, for some reason, should bench charging be required, a slow rate of charging is always beneficial. So, whenever you take a battery to a shop for charging, do not be in a hurry to get it back quickly. As a thumb rule, 1 ampere per positive plate is a safe charging current. A battery is considered to be fully charged if the specific gravity does not increase for a period of two hours and there is free gassing (bubbles coming out from the electrolyte). As charging is an exothermic reaction, the temperature of the electrolyte increases during charging. The electrolyte temperature should not be allowed to exceed 50 degree Celsius.

Battery failures:

Battery failures can be classified into four basic types: Overcharging, Sulphation, Internal Short Circuit and Cyclic.

Overcharging: An alternator with a defective regulator can overcharge a battery at higher voltages. Normally

an alternator charges at around 27.5 to 29.5 volts for a 24 volt system, where 2 x 12V batteries are connected in series. Charging at higher voltages produces excessive heat, which causes the positive plate to expand and warp. The separators become brittle and begin to crumble.

Hence, during maintenance, if you notice that there is high loss of electrolyte due to evaporation, or the battery body becomes abnormally hot, at once, check the alternator charging voltage and correct the problem. In a situation as this, the bulbs and solenoids will fail prematurely. The insulation of the cables will deteriorate very fast or can even melt.

Sulphation: When the battery discharges, the active material on the plates gets converted into lead sulphate. If batteries are left in discharged condition for a long time, lead sulphate becomes hard and resists re-conversion to lead peroxide.

Precaution: Do not leave batteries in discharged condition for a long period. Batteries should always be kept in charged condition. If the machine has to remain parked idle for a long period, remove batteries and give it a trickle charge on the bench to keep it in healthy condition.

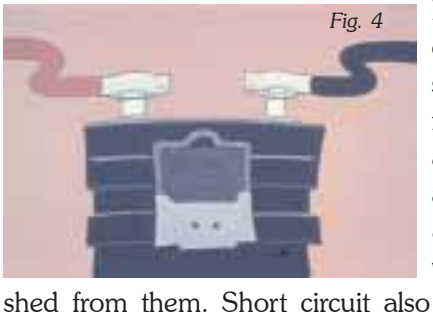


Fig. 4

Internal Short circuit: Internal short circuit results from bridging of active material across the negative and positive plates which has been shed from them. Short circuit also results due to the failure of separators.

Precaution: Batteries should be clamped on the machine properly, so that vibration is kept to minimum. Normally the vibration level in an earthmoving machine is very high; hence, proper clamping becomes all the more important.

While replacing terminals, people forcibly tap the terminal in, causing the active material to fall, inviting a short circuit. Remember that the terminals are of different thickness and tapered, the +ve thicker than the –ve. Similarly, the terminal connectors are also different and have a taper. Thus, it will slide in easily, only if connected in the right direction.

Cyclic Failure: This is a normal failure during the course of battery life, as it is repeatedly charged and discharged. The active material contracts and swells during the cycle. This makes it to loosen and get washed out of the plates. The material falls to the bottom of the cell and will ultimately cause short circuit.

Battery Maintenance:

Battery requires very little maintenance for its proper upkeep. The key areas are listed here:

1. Electrolyte level should be checked once every week. The electrolyte should cover the plates at all times, which is the minimum level. The higher level should be such that the vent plugs are always exposed, and not covered. During charging explosive hydrogen gas is released, which if not vented out can result in bursting of the battery. During operation, the sulphuric acid in the battery gets converted into water while discharging and back to acid during charging. Hence, there is no loss of acid. Therefore, during top up only water needs to be added. As normal tap water contains minerals, we should use only distilled water for topping up the electrolyte. Acid should NEVER be added. In case there is electrolyte spillage, the area where the electrolyte has fallen should be washed with water, as the acid will corrode the metal parts if allowed to remain, and electrolyte should then be added in a Service Shop and bench charged.
2. The vent plug has holes to release the gases that are formed during the working cycle. Care should be taken to ensure that the vent holes are clean and not blocked with dust and dirt.

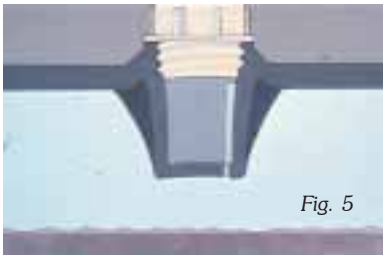


Fig. 5

3. The terminals get sulphated due to oxidation. The terminals and the battery should be kept clean. Water is the best cleaning agent, and battery can be cleaned with water alone. Apply petroleum jelly or vaseline to protect the terminals from sulphation. In case it is not available, leave it clean without any coating. Do NOT apply grease on the terminals, as they do more harm than good.
4. Ensure that the terminal connections are tight. In-fact, it is rule No. 1 that all electrical connections must be tight, and battery is no exception. Loose connections lead to spark and improper conductivity. A healthy battery with loose terminal connections will fail to crank an engine. Also, ensure that the batteries are properly clamped to arrest vibration.

And finally one should never forget some points while handling electricals and batteries in particular.

1. While handling batteries, ensure that you remove the negative terminal first and connect it last. In a negative earthed system, the circuit will not be complete unless the negative is connected; hence, all sorts of spark will be avoided.
2. Use tools with insulated handle. This will avoid short circuit in the external circuit. Do not wear metal rings and wristbands or wristwatches while working on electrical systems.
3. Do not check the health of a battery by short-circuiting the two terminals with a conductor. This produces a spark which, can cause burn injuries, and at the same time damages the battery by drawing very high current which causes erosion and damage to the battery terminals. Special cell tester is available commercially, which can be used to check the condition of each cell.
4. In case the electrolyte enters the eyes, immediately wash with lots of water, and go to a doctor and get medical assistance (Fig 6).


Fig. 6

Watch out for basic laws of electricity and how the same is employed on earthmoving machines in the forthcoming issue.

Customer Interview: G.M. EXPORTS

M/s.G.M.Exports is managed by Mr. Raju Bora, Mr. Gautham Bora and Mr. Ajit Bora – three brothers from Ilkal in Karnataka. They started the Granite business at a very young age. This was unconventional for the Jain Marwari community; besides it was not easy to start this business without the family support.

The Bora brothers – Messrs Raju, Ajit and Gautham

Mr. Gautam Mangilal (grandfather of Bora brothers) came down to Karnataka from Rajasthan about 80 years back and settled down in Ilkal when the area was totally underdeveloped. He started the traditional business in fabric and other trades, but could not succeed much financially.

"Though the area was identified for its rich granite deposits, there was no way of exploiting it." says Mr. Raju and continues, "We used to travel to the mines on scooter with two to three people sitting on it."

Having started as traders in the year 1986, in the name of Jain Granites, their job initially was to act as intermediaries and get their margin. "This continued till we got the foothold financially. Having gained knowledge in the business and realizing the market potential, we started acquiring land for mining. Now, with an area of 150 acres of patta land, we have enough area to mine," says Mr. Ajit. As the business grew in the year 1992, they rechristened the firm as G.M. Exports with wider area of operation.

"The famous Ilkal granite has ever-increasing demand world-over, but we have restricted our exports to Taiwan, Bangkok and China for want of supply. There is no need to market this product. It is purchased from the site. We sell blocks in the required sizes." says Mr. Raju Bora. To meet the domestic demand, 15% of the production is utilised and the balance is exported. Having been in the trade for 20 years, Bora brothers have mastered the trade. "When we were novices in the market, we used to deal with an agent for exports. It does not take much of a time to learn the art, if you are keen in it." Recalling the initial years, Mr. Bora says, "All the mining activities were done through manual labour and it was economical to meet the then demand, but as the industry grew, to cope up with the demand, one had to mechanise. If not, one would be left behind."

"The actual commercial mining started in the year 1995. Though we have a vast area unexploited, we operate in four mines right now. We never believed in owning the machines; hence, in the last 6 to 7 years, we hired machines for our operations. It was becoming too exorbitant to pay the rentals. Hence, in the year 2004, the first L&T-Komatsu PC 200-6 was purchased after seeing the performance of the hired machines in our mines. Now, we own two L&T-Komatsu PC200-6 hydraulic excavators and regret for not taking the decision of buying the machines earlier," says Mr. Ajit Bora.

The current turnover of the organization is Rs. 7 crore. It helps around 300 people to earn their livelihood directly or indirectly.

The first machine has clocked 3000 hours of working without any problem in a span of eight months and the second machine has clocked 1600 hours of working in six months. The machines are operated on an average of 10/12 hours a day and the maintenance part is taken care of by the operators. "These operators may not be trained but experienced," says Mr. Raju Bora and continues, "At the end of the day, the operators check the machines and do the requisite maintenance. We have the production obligation of 400 cu.m per month for the export market. That has to be met and these blocks are mainly exported to China. Though we do not have formal education, we are able to manage the communication with foreigners." On quality of granite, Mr. Raju quotes, "as we go deep in the mines, the quality improves, but only we need to check whether it is an economical proposition. May be now the product is available in abundance, we do not go deep beyond a certain limit. As it becomes scarce, we may explore such adventures," he concludes.

Though the brothers visit the mines daily, they have a clear understanding on operational aspects. Mr. Gautham handles commercial, Mr. Ajit handles production and Mr. Raju takes care of marketing.

The organization is not planning for any diversification as of now and the full focus is on granite business since the going is good.

"With the long term vision of achieving Rs. 50 crore turnover after five years, the organization may diversify into other fields and become a private limited company," says Mr. Gautham Bora.

L&T's KSM 304 SURFACE MINER

Larsen & Toubro Limited (L&T) has introduced the indigenous Surface Miner Model KSM 304 in the country. This equipment has been designed and manufactured at L&T's Kansbahal Works in Orissa. To meet the growing demand in the mining sector, the need for the Surface Miner was felt and L&T developed the indigenous model to cater to this segment.

L&T's Kansbahal Works has ISO 9001 accreditation for design, manufacture and service. Besides, it also has ISO 14001 certification for Environment Management System.

Surface Miner Model KSM 304 comes with Cummins India model KTA38C, turbo charged after cooled and water cooled diesel engine developing 1200 HP @ 1900 rpm. The operating weight of the machine with tanks, duly filled, is 115 ton while the tare weight is 100 ton. The fuel tank of this Surface Miner has a capacity of 2700 litre, while the hydraulic tank and water tank are having capacities of 1550 litre and 10800 litre, respectively.

The operating speed is 0-20 M/min, while the travel speed of the Surface Miner is 0-2 Km/Hr.

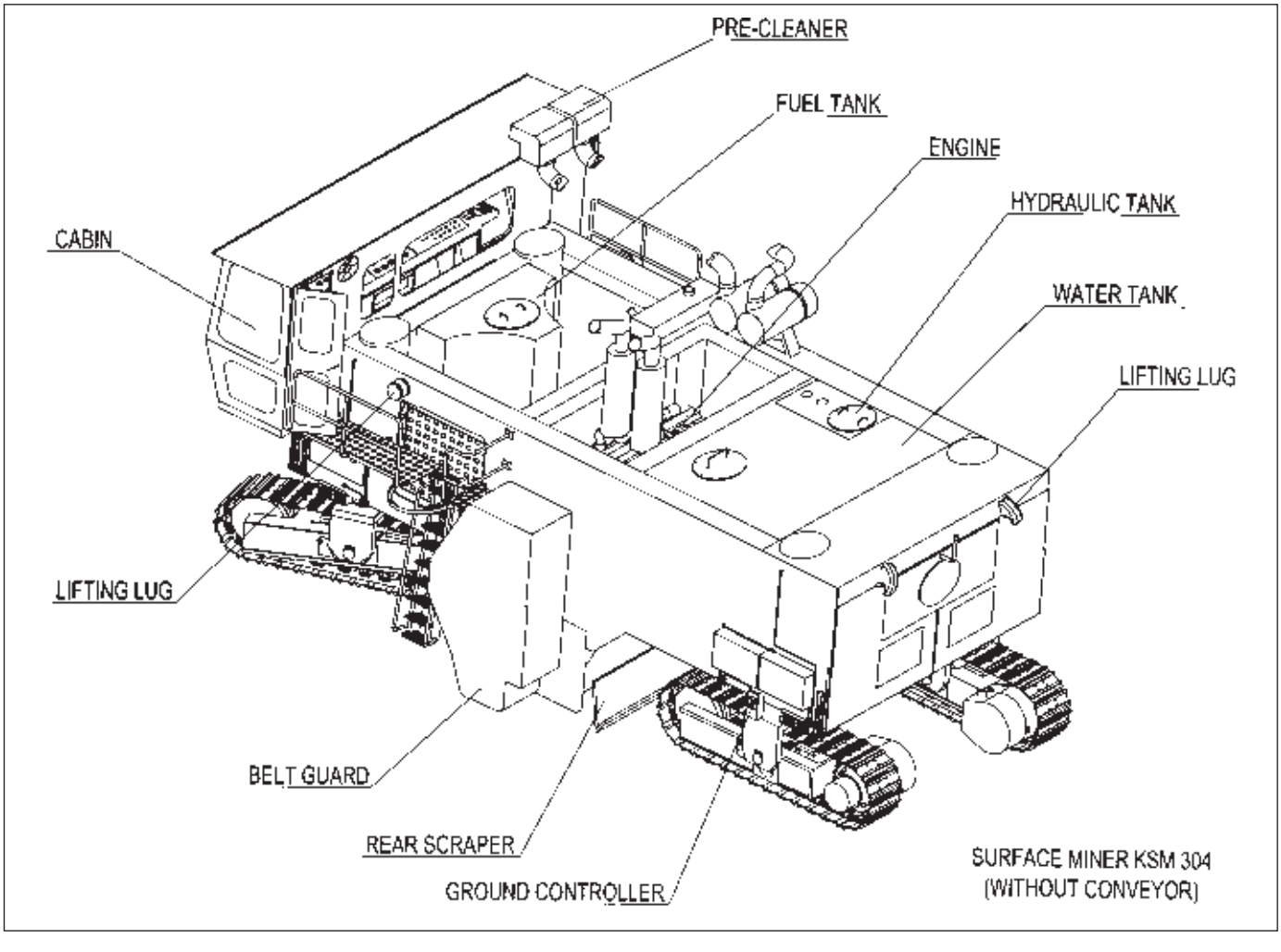
The cutting drum can go upto a depth of 0-400 mm, has a width of 3000 mm and diameter of 1350 mm, which includes the cutting tools.

This model is offered with conveyor as an optional attachment for facilitating direct unloading onto tippers. Air-conditioned operator cabin is also offered as an optional feature.

A smaller Surface Miner – Model KSM 223 having a drum width of 2200 mm, cutting depth of 0-350 mm, travel speed of 0-5 Km/Hr and powered by 800 HP engine operating @ 1900 rpm is also available.

Some of the advantages of using a Surface Miner are:

- Environment-friendly
- Minimum loss of mineral
- Usage at the place, where blasting is not permitted.
- Primary crushing of material is completely eliminated.
- Economical to operate compared to the belt conveyors/dumpers.
- Manpower requirement is minimum.



Features:

- Spacious operator cabin with dual control panels and wide visibility
- Emergency drive – In the event of main drive failure, by activating an emergency drive system, the equipment can come out of the difficult terrain.
- Independent track drives for easier maneouverability
- Hydro generator
- Four side water spray
- External lubrication oil cooling system
- Large fuel and water tanks
- Auto height and slope sensors.
- Automated safety features.

L&T's KSM 304 has been designed to suit Indian working conditions and is your best bet for continuous mining.

For more details contact: meb@pro.ltindia.com

Customer delight is our top priority. Sale of any equipment does not end by delivering the machine. After-sales-support is as important, if not more. The expression of appreciation can be in many ways. One of them is through letters.

Phone : 2320631, 2321730, 2325694
Fax : 0744-2450027

R.S.T. No.
C.S.T. No. 2033/01271

KANHAIYALAL RAMESHWAR DASS

MINE OWNERS : PATTI, FARSHI, POLISHED ACID & ALKALI PROOF SAND STONES

"RISHABH BHAWAN"
New Colony, Gumanpura,
KOTA - 324 007 (Raj.)

Date .....

05/07/2005

Ref. No.

M/s Larsen & Toubro Limited
D-24, Prithvi Raj Road
'C' Scheme
Jaipur- 302001

Subject :- Our Experience with L & T Komatsu Hydraulic Excavator

Dear Sir,
We are owner of 2 Nos. L & T Komatsu Hydraulic Excavator PC-200 bearing Sl.No. NL 10099 & NL 10842. We have bought the above machine replacing Telcon Ex service machines, which we had operating since long.

We would like to state that L&T Komatsu machines working with us have been performing extremely well. Production of L&T Komatsu machines is more comparing to others machines and also m/es having less down time. The product we have found is reliable & average life of hydraulic cylinders seal kits is more than 8000 hours. We have overhauled our Engine of the machine only once till date, at 18225 of working hours. We have not opened or repaired major components like swing gear, Hyd. Pump, Valve bank, motor etc. we are extremely happy with the life of track chain, which is close to 22,000 hours of operation.

The service & parts support for the equipment is excellent and response received by us from your people is also up to our expectation.

We would like to thank you for the support and co-operation extended and looks forward to a continuing fruitful and cordial relation.

Thanking you

For Kanhaiya Lal Rameshwar Das

Suraj Mal Bansal

(Suraj Mal Bansal)
Partner

TRAINING PROGRAMME

At Goa – V.M. Salgaocar's Site

Training programme was conducted at M/s. Salgaocar's site at Goa for maintenance engineers, supervisors and maintenance staff. The focus was on the Hydraumind and CLSS system of Komatsu machines. Besides the coverage on the special features, hands on training on the machine was also imparted.

A full day session on safe operation of the machine and maintenance was conducted for the operators and mining engineers. The topics covered included component layout and special functions of the monitor panel.

The programme was organized by the Construction Equipment Business team of L&T's Goa office and personnel from Training Centre, Bangalore.

Mr. R. S. Kamath, CEB-Goa, making a presentation during the programme.

View of the participants

Mr. Subramanian, GM, Mines, V.M. Salgaocar addressing the participants

At Lakkha

L&T's Construction Equipment Business Unit of Jaipur and Udaipur organized a training programme for operators and mechanics at Ujjawal Granite Pvt. Ltd. Mines at Lakkha, Jaisalmer. Besides the participants from Ujjawal Granites, many operators and mechanics from other organizations also attended the programme. The focus of the programme was on features and maintenance of PC200 and PC300 hydraulic excavators.

Training programme in progress

Participants being given "hands on" training

Pavan Ganga Enterprises

Mr. Ravindra Krishnagouda Tammanagoudar

Mr. Ravindra Krishnagouda Tammanagoudar, Managing Partner of M/s. Pavan Ganga Enterprises, R/O Hulkot Taluk, Dist. Gadag, had a clear vision to pursue the business after completing his graduation with PGDBM. Though the family was mainly involved in agriculture, parallelly they were also in transportation business plying 2/3 trucks for several years. But for the truck business, when the going was tough with lot of problems, they decided to diversify the business and ventured into construction equipment hiring. "It was during this period, the people in our area with agrarian background were going for hiring of machines and prospering; I also got the idea of going for a greener pasture," Mr. Ravindra says.

Travelling through the memory lane, Mr. Ravindra says that his father who was employed for over 28 years, opted for voluntary retirement and started the new business in Cattle & Poultry Feed Supplements with vast experience gained during his employment. Though the business was good initially, he found it unsatisfactory in the subsequent years until the situation forced him to diversify into different business. "It was also the coincidence at the time of closing down our transportation business to realise the demand and business potential by seeing quite a lot of bulldozers and other allied machines working in the area," he says and continued, "As the time passed, most of the people in our village had such machines and ventured into this new business. Hence, I, having decided to enter this line of business, bought the first L&T-Komatsu PC71 in February 2003, without any idea or much knowledge. But, the buying decision took place impulsively just based on the feedback received from friends who visited Bangalore and saw this machine in the exhibition. Though there were not many L&T machines in our area, I purchased this machine because of its appearance and it is from L&T-Komatsu. Once the machine proved to be lucky and profitable with less maintenance and good product support from the company, I went for another landmark machine in February 2005 i.e., 100th L&T-Komatsu PC71 in Karnataka."

He says, "Since the risk factor is more in this line of hiring business with irregular payments and uncertainty in continuous business, I need to monitor this business personally. I do inspect the site before giving the machine on hire, if the site is far and the person taking the machine on hire is unknown to me. Also, I restrict the area of hiring operation within 250 KM radius from the feasibility point of view." Mr. Ravindra feels that though Cattle & Poultry Feed Supplements is the core business, it is the hiring business, which has good future and gives good return.

"We have some trustworthy operators to handle the machines efficiently and maintain well with the guidance and support of L&T, without giving any tension to us. We also ensure that the machines are periodically checked as per company's schedule and directions," says Mr. Ravindra and continues that his B.Com. and PGDBM qualifications have helped him in his business, though he did not pursue employment after studies. He asserts that the decision of switching over from one business to another is possible only with the help of family support and risk taking ability.

Mr. Ravindra concludes by saying, "I devote much of the time to business, while my father takes care of finance/accounts. I may go for more L&T-Komatsu machines, as the going is good. My vision is prompt payment, job satisfaction and growth as the time comes."

100th L&T-Komatsu PC-71 in Karnataka being handed over to Mr. Goudar.

"Team work is the work towards a common vision. It is the fuel that allows uncommon people to attain common Results"
– Anonymous

Key Handingover Ceremony

The Uralungal Labour Contract Co-operative Society Ltd. (ULCCS) is a Co-operative Society registered under the Co-operative Society Act established in 1925. One of its activities is infrastructure development and, therefore, it is in construction field in North Kerala.

The Society has more than 1000 workers with 293 regular members. It has been recently awarded works viz.,

- Koilandy-Muthambi-Arekulam road
- Kollam-Nelliyadi-Mepayoor road

Though ULCCS owns fleet of other machines, it has now been brought into L&T's fold by supplying L&T-CASE 851 Backhoe Loader.

L&T-CASE 851 Backhoe Loader key being handed over to Mr.Ramasan (President ULCCS). Personnel from L&T-CASE dealer, Kadoor Sales Corporation, Calicut are also seen.

Customers' Meet at Imphal

L&T-CASE had organized a customer meet at Imphal on 16th March, 2005 jointly with their dealer M/s. Automobile Engineering Works. The meeting was attended by 60 customers from both Private and Government Sectors like Loktak Development Authority, IFCD, and PWD officials from Manipur. L&T-CASE was able to make breakthrough in Manipur State bordering with Myanmar through local dealer Automobile Engineering Works in January 2005. The customers were given an overview of the features, benefits and after-sales-support of L&T-CASE products, which was highly appreciated by them. On this occasion L&T-CASE 851 Backhoe Loader demonstration was also organized. The customer meet was even more eventful as an order for L&T-CASE 851 Backhoe Loader was placed by Mr. M. Chauba Singh, during the meet.

Present on this occasion from L&T-CASE were Mr. Arun Pai, Head – Marketing, Mr. D.V. Junnarkar, Head – Sales Development, Mr. P.K. Bhattacharya, Head – East Zone, and others.

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