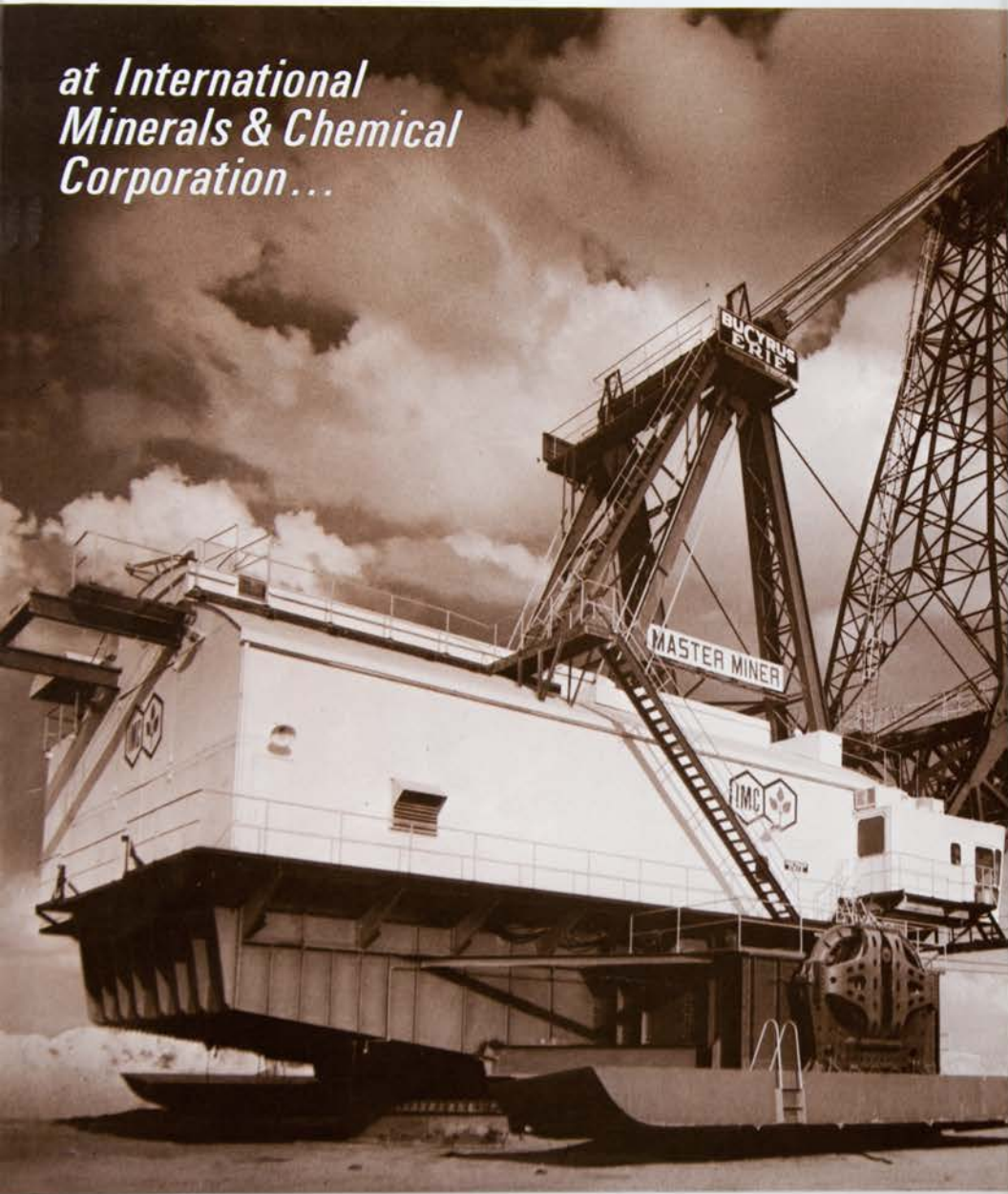


*at International
Minerals & Chemical
Corporation...*



35 yard Bucyrus-Erie dragline removes phosphate ore from open pit mine at IMC Achan operation. Its Lincoln lubrication system utilizes three circuits, servicing 230 points on the digging system, the circle rail, and the walking mechanism.



"LINCOLN'S CENTRO-MATIC lubrication systems have a definite part in our Preventive Maintenance-Lubrication Program as modern lubrication is concerned with considerably more than just the lubricant involved," said J. H. Andrews, chief engineer for International Minerals & Chemical Corporation's phosphate operations headquartered at Bartow, Fla.

IMC is the only international supplier producing all three basic fertilizer ingredients—phosphate, potash and nitrogen. At its Florida operations, the company strip mines phosphate and converts it into a dozen different agricultural products. The IMC complex for phosphate mining and processing is the largest and most diversified of its kind in the world.

"IMC's first Lincoln Centralized Lubrication System was placed in operation in February, 1962, and services a 35-yard Bucyrus-Erie dragline, the "Master Miner", at IMC's Achan Mine. The next Lincoln system was installed in a Michigan tractor-shovel being used as a front-end loader in the triple superphosphate storage building at the Bonnie chemical plant. In November, 1962, the two Prayon Filters in a new phosphoric acid unit were equipped with a single Lincoln centralized lubrication system. The latest installation of Lincoln lubrication equipment, now underway, will convert a total of 224 lubrication points throughout a phosphate ore washing plant.

F. W. Carrier, IMC lubrication engineer responsible for the design and installation of these systems, stated, "Lubrication systems are essential. They provide uniform control of lubricant application to give reductions in maintenance, longer equipment life, labor savings, and production gains."

THE BUCYRUS-ERIE dragline removes phosphate ore from an open pit mine and dumps it into a sump, where it is mixed with water to form a slurry. This Lincoln system utilizes three lubrication circuits (separate circuits for the digging system, the circle rail, and the walking mechanism) with a total of 230 lube points. All points are serviced by a Centro-Matic Model 1827 pump, which includes an electric operated, fully automatic Master Control and Signal Monitor. The pump is mounted directly on a 120 lb. original refinery drum of NLGI #1 EP lead base grease.

**"LUBRICATION
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The main supply lines of the dragline system consist of 400 feet of schedule 80 3/4" and 1" steel pipe for all circuits. Approximately 200 pounds of lubricant are required per month by the three circuits.

THE MICHIGAN tractor-shovel equipped with a Lincoln Centralized Lubrication System is one of four operating in the triple superphosphate storage building at the IMC Bonnie plant. The four units (only one of which has the Lincoln system) are used as front-end loaders, digging into piles of highly corrosive triple superphosphate.

The Lincoln system lubricates all bucket hinges and the steering system of the tractor-shovel. About 45 SL-33 injectors are included in the system, which is supplied with lubricant by a Lincoln Model 82653 Ram Pump with a 4-way valve operated by the action of the dumping lever.

At left, SL-1 injectors in foreground serve cable guide pulley on dragline. Note connector tube between injectors, which allows output of two injectors to be combined for application to a single bearing.

The digging system circuit involves 92 lubrication points, all equipped with SL-1 single and multiple injectors, which lubricate all hoisting and drag mechanism sleeve bearings and some non-friction bearings. While the dragline is in operation, practically all these bearings are exposed to reversing shock loads (up and down, back and forth). The digging system circuit is manifolded by means of schedule 80 3/4" and 1" steel pipe. The Master Control is set for a lubrication cycle of 20 minutes.

The circle rail circuit lubricates the 116 dolly rolls, which support nearly the entire weight of the dragline. Lubrication is done once a day, in less than ten minutes, while the dragline is not operating. This is necessary because the circle rail circuit is disconnected from the lube pump and the other two circuits during dragline operation. The sleeve bearings of the rollers are lubricated by 116 individual SL-1 injectors manifolded to the 3/4" schedule 80 steel line mounted around the perimeter of the circle rail. For lubrication the circuit is connected with a Lincoln high pressure lubricant hose to the main line, after which the pump is activated by manual control.

The propelling or "walking" mechanism circuit has 22 lubrication points, each equipped with SL-1 series injectors. These lubricate all sleeve bearings that provide support for the cam-action levers which "walk" the machine. Although it is manifolded with the digging system circuit, the walking mechanism circuit is controlled by a cam-operated 4-way valve to apply one lubrication cycle per step.



Worker adjusts SL-1 injectors on drag hoist drum. Individual injector adjustment gives each bearing precisely measured amount of lubricant, eliminates waste.

The very nature of the central lubricating system flushes and cleans the hinges and linkages, while lubricating automatically. The other three machines are still manually lubricated, which requires about 30 minutes per unit each day. These units will be replaced by new equipment this year, and centralized lubrication is planned for the new loaders.

The major Lincoln Centralized Lubrication System in the IMC Bonnie plant is involved in the operation of two revolving Prayon Filters installed in the phosphoric acid plant. The diameter of each filter is approximately 48 feet, and each consists of 24 filtering cells with a total filtration area of 745 sq. feet.

The system uses a single Lincoln Model 1827 Centromatic drum pump with electric Master Control and Signal Monitor, supplying a total of 252 lube points on both filters. The pivots of the two rotating filters are located some 80 feet apart, and the pump, mounted on

folds from the main supply line into a 20' circular line to the inside guide rail rollers and thrust rollers lube points. A third branch line connects the main line with another stationary circular line carrying lubricant to the outside guide rail rollers and thrust rollers, as well as the rotating ring gear, which is lubricated by a Lincoln Mistomatic spray unit.

The rotating filter head consists of a lead-surfaced stationary distribution valve disc and a lead-surfaced rotating valve head, both 48" in diameter. Three Lincoln series SL-1 injectors, installed on the perimeter of the stationary valve disc, provide lubrication of the two lead surfaces, as well as a seal for the 28" of vacuum which separate the acid material by pulling it through filter cloths. The system has a difficult job to do in lubricating the rotating filter head. Lead sliding against lead under a vacuum increases pressures and the tendency is for grease to be sucked into the stream, making lubrication complex and very critical.



SL-1 injectors serve the rolls on the circle rail of dragline. Important benefit of the Lincoln system is elimination of lubrication downtime; manual lubrication required daily shutdown of 1/2 hour, with consequent production loss.

a standard 55-gallon drum, is situated equidistant from the pivot points, or 40 feet from each pivot point. The pump develops lubricant pressure of 2,500 psi at an operating air pressure of 100 psi. Adjustable within a range of 3 3/4 minutes to 3 hours, the pump is set to lubricate each point every 24 minutes. Lubricant used is NLGI #2 Inorganic Base Grease.

EACH OF THE TWO filters is equipped with three lubrication circuits, which supply the rotating filter head, the tray bearings and tray pivots, the rotating ring gear, the inside and outside guide rail rollers and thrust rollers. The Lincoln pump is connected to each filter by a main supply line of 1" schedule 80 steel pipe with forged fittings. At the pivot point of each rotating filter is a high pressure swivel which is connected to the pump, 40 feet away. Lubricant is pumped through the swivel and a 25-foot long branch line to the 3/4" rotating circular line leading to the tray bearing and tray pivot lube points. Another 25' branch line mani-

A particularly unique application in this system is the lubrication of the pivot and tray bearings, because of the 180° tripping action of the filter trays. With the aid of Lincoln engineers and special engineering services supplied by L. H. Travis Company (authorized Lincoln distributor, Doraville, Ga.), the contractor was able to lay out the lube points and flexible feed lines so they would not tangle in operation. Each filtering tray is equipped with two guide rolls and one pivot. These maintain a level tray position as the unit travels around during the filter rotation, and cause the trays to tilt 180° (guided by the tripper rail) for dumping and subsequent return to the horizontal plane for continuous operation. One Lincoln Series SL-33 injector provides lubrication to each pivot and to each tray bearing. The pivots turn in bronze sleeve bearings, while the rolls move around anti-friction bearings.

The rotating ring gear around the perimeter of each filter is spray lubricated by a Mistomatic installation, which consists of a Lincoln injector spray control assem-



IMC lubrication engineer, at left, inspects SL-1 injectors on rotating filter head.

injector to be individually adjusted, so there is no lubricant waste—always a factor to contend with when manual methods are used. Automatic lubrication also contributes to better housekeeping, a vital factor in both safe operation and better employee performance.

IMC is now converting the Noralyn Washer Plant from manual lubrication to a Lincoln Centralized Lubrication System. The washer consists of trommels, which screen out the largest impurities; hammer mills, which break up the mud balls of higher grade phosphate clay from the trommels; screens; log washers, which break up material from the screen into sand, clay and phosphate; then another series of screens, log washers, and screens, after which the pebble phosphate is conveyed to the stock pile.

THE MOST ADVERSE site for a centralized lubrication system in the washer exists at the three hammer mills, so that is where the first Lincoln system was installed. Lubrication is accomplished on a four-minute cycle by introducing 100 psi air direct, i.e., without nozzle or valve, through the unrestricted or unorificed air line to the lubricant in the three lube points which service each bearing. This is done to increase the flushing action. The three Lincoln Series SL-1 injectors are mounted ten feet from each bearing, and are manifolded to the lube points by Nylon tubing. The system is supplied from one Lincoln Model 1827 Centro-Matic pump mounted on a 55-gallon drum, controlled by an electrically-operated Master Control unit. Specifications for this pump are the same as those for the Prayon Filters pump in the Bonnie Plant.

Lincoln Mist-O-Matic unit, shown below, spray lubricates rotating ring gear around perimeter of each filter.



bly, a pneumatic atomizing nozzle, and a Series SL-1 injector.

BOTH INSIDE and outside guide rail and thrust rollers are mounted at the bottom of the support frame—the thrust rollers below, and the guide rail rollers beside, the guide rail. They provide vertical support and lateral precision of the rotating movement. There are 15 pairs of these rollers installed on the outside rail and 10 pairs on the inside rail. Each anti-friction bearing of these rollers is lubricated by a Lincoln Series SL-32 injector.

"We decided to install a centralized lubrication system on the Prayon filters because we were convinced that such systems are a direct method of dependable controlled Preventive Maintenance Lubrication," stated Mr. Carrier. "Manual lubrication would require a minimum of 15 minutes downtime per day on each filter. This plant operates around-the-clock, seven days a week, so any downtime on the filters, which handle the entire plant's production, would immediately affect our total production."

Safety is another point to consider when comparing centralized lubrication to manual methods. An oiler would have to work close to operating trays to lubricate without shutting the filters down, and this would not be safe. The Lincoln automatic system allows each

The complete system for the Washer Plant will include 224 lubrication points, located on drive chains, open and closed gears, speed reducers, a number of sleeve and anti-friction bearings, and pump bearings. The main supply line consists of $\frac{1}{2}$ " schedule 40 steel pipe. Feed lines from injector bearing are of $\frac{1}{4}$ " and $\frac{3}{8}$ " Nylon tubing.

"Manual lubrication of the washer, performed while it was in operation, required six hours per day," said Mr. Carrier. "Before we decided to convert to centralized lubrication an extensive study was made of all possible cost factors—manpower, maintenance, bearing life, etc. The result indicated that with centralized lubrication, we would save about \$8,000 a year—on a \$6,040 investment! The

investment costs include our own personnel installing the Lincoln system as scheduled maintenance. We expect to have the entire system installed by spring."

The unique solution to the problems involved in the hammer mills application was designed and installed in cooperation with Lincoln's engineering service; the rest of the system is being built around the demands of the hammer mills, which are critical because of the rock-contaminated water which tends to wash out the lubricant and introduce abrasive materials. The Lincoln system's inherent flushing action keeps the bearings clean of these abrasives, and should therefore increase bearing life considerably.



A single Lincoln Model 1827 Centro-Matic pump serves both rotating filters. Centro-Matic Master Control, adjustable within a range of $\frac{3}{4}$ minutes to 3 hours, is set to lubricate each of the 252 lube points every 24 minutes.