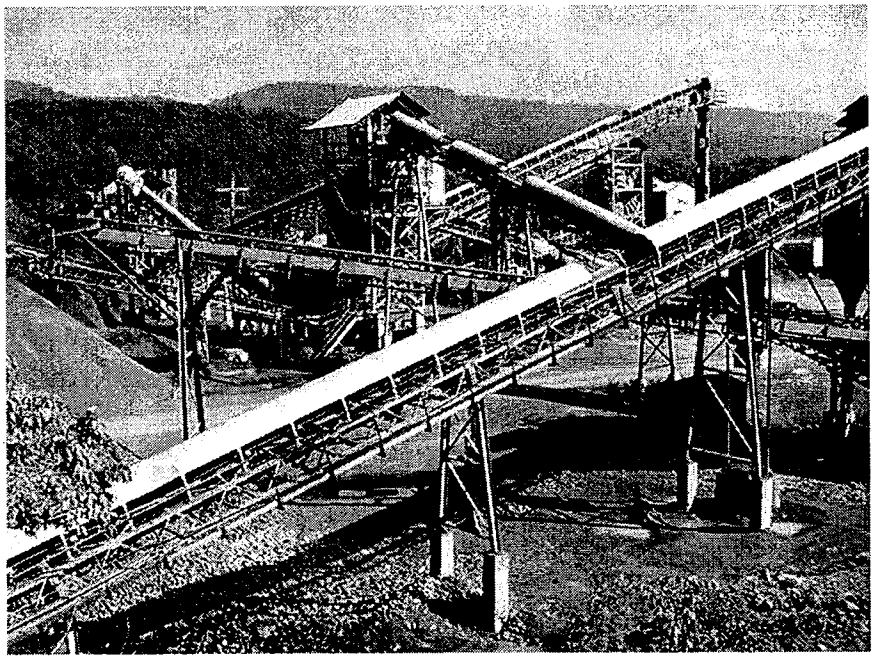
MODULE NUMBER 4
OF
INSTRUCTION GUIDE NO. 40

ON-THE-JOB TRAINING
FOR THE
SAND, GRAVEL, AND CRUSHED STONE INDUSTRY

PLANT OPERATION



For the job of plant operation, this module describes the basic job steps, potential hazards and accidents, and the recommended safe job procedures.

These job steps are usually done by the plant operator, and other occupations, such as utility worker, laborer, etc. The plant operator/utility worker must make sure that employees, and others, are protected from accidents and injuries resulting from plant operations.

While both sand and gravel plants, and crushed stone plants, are built by many different manufacturers, the processes and equipment involved in the production effort are very similar.

SAND AND GRAVEL PLANTS

At a typical sand and gravel plant, raw material from a hopper at a dumping station is carried by conveyor belt to a screening deck. The screening deck removes oversized material (large clay balls, roots, very large rocks, etc.), separates sand from gravel, and then separates the gravel into different sizes. Spray bars wash the gravel as it passes through the screening deck.

Large stones then go to log washers, while medium size material (chat and/or pea gravel) goes to a screw. The large stones, after emerging from the log washer, and the finer material, after emerging from the screw, pass through separate final rinse stations on the way to storage areas. Transportation to a storage area may be by a fixed conveyor system, a radial stacker system, or an extendable belt conveyor system. A radial stacker is a conveyor system, that rotates from a stationary pivot point and stores the material in an arc-shaped stockpile. The extendable belt conveyor system has the capability of lengthening or shortening itself by moving the head section. The head section is mounted on wheels and moves on rails, which allows the conveyor to supply several stockpiles, hoppers, or silos.

Sand, after being separated on a screening deck, flows to a classifier, where it is washed and sized. The sand is then carried by a screw, which separates the sand from the water, to a conveyor belt, which carries the sand to a storage area.

Water, that is used in the plant, is pumped from a fresh water pond. After use, the discharged water is pumped into a settling pond.

CRUSHED STONE PLANTS

A crushed stone plant differs somewhat from a sand and gravel plant. Raw material, of various sizes, is brought from a quarry, to a primary crusher, by haul units. Some primary crushers are fed by wobblers, which are chain driven conveying systems, with eccentric rollers.

After primary crushing, material is conveyed by belt to a scrubber for washing. The scrubber is a cylindrical rotary device with internal screens, and auger-type vanes that carry the material through the scrubber. Very fine material is separated from coarse material in the scrubber. The very fine material is sent to a settling pond. Coarse material is sent first to a surge pile, and then to a primary screening deck. Oversized material is carried from the primary screening deck to a secondary crusher, and is then returned to the primary screening deck to be separated into desired sizes. A crushed stone plant contains a series

of screen decks, secondary crushers, and final rinse screening stations. The finished product travels through a final rinse stage, and is then stored in silos, bins, and stockpiles.

A sand and gravel, or crushed stone, plant consists of a number of interdependent production processes, which occur simultaneously. Therefore, it is important to know how the plant operates, in order to prevent a massive pile-up of material at transfer points during plant start-up, operation, or shutdown.

PRE-SHIFT INSPECTIONS

Before initial operation on production runs, a careful and detailed inspection of the plant, and all of its components, should be conducted. Check the alignment of all mechanical components. Also, check the operating alignment of the belts on the carrying rollers and the return idlers. Visually inspect the belts for defective splices. Be sure that all moving parts have guards in place.

Check that there are no construction materials, tools, or projecting members that can rub, tear, or cut the belt when it is started. Be sure that chute skirtboards are intact, and are not touching the belt. Adjust rubber edging strips on skirtboards, so that they touch lightly on the belt surface. Adjust belt scrapers, if necessary.

WALK-THROUGH INSPECTIONS

Walk through the plant soon after it has started. Listen for any unusual sounds made by idlers, pulleys, shafts, bearings, drives, bolts, and belt splices.

Walk-through inspections of all plant equipment should be made several times each day, during the operating shift. Guards, safety devices, and warning signs should be checked to determine that they are in proper position, and in good working order. Only competent, properly trained, and authorized persons should repair defective safety devices.

Although a stuck idler may not appear to be important, plant operators should realize that, if an idler is stuck under a high-speed belt that is handling abrasive material, the shell of the idler will soon wear through, causing a knife edge that will severely damage an expensive belt. Plant operators should be alert for impending idler failures, and correct the malfunction before the belt is damaged.

LUBRICATION AND REPAIR

A comprehensive lubrication program is essential to attain low maintenance costs, and dependable plant operations. Pay particular attention to lubrication of all bearings. Equipment life will be extended by following the manufacturer's recommendations for types of lubricant, amount and frequency of application, and type of greasing equipment to be used.

People can become entangled in moving parts while lubricating equipment. Extended grease fittings and hoses allow moving equipment to be safely lubricated. Equipment must be shut down and locked out, if lubrication requires either the removal of guards or the placement of people in dangerous positions to perform the job.

Frequently used repair parts should be stocked at the plant site to maximize plant dependability and productivity, and to minimize maintenance costs and downtime.

Since plant equipment operates automatically after start-up, "plant operation" under normal conditions consists primarily of inspection, maintenance, and clean-up.

The following safe job procedures will help to minimize incidents which may cause injuries, and adversely affect production.

REQUIRED OR RECOMMENDED EQUIPMENT:
HARD HAT, STEEL-TOED SHOES, LIFE JACKET, HEARING PROTECTION, SAFETY GLASSES

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. A) Visually inspect "V" belts.	1. A) Slipping/falling.	1. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
	B) Mechanical hazards (body or clothing caught in machinery).	B) Make sure guards are in place and adequate, and that clothing fits snugly.
2. A) Visually inspect conveyor belt idlers, belt splices, and stop cord. Listen for noisy, defective bearings.	2. A) Slipping/falling.	2. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
	B) Mechanical hazards (body or clothing caught in machinery).	B) Make sure guards are in place and adequate, and that clothing fits snugly. Do not touch idlers.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. Visually inspect head section of conveyor for loose lagging. Report and/or repair defective lagging.	3. A) Slipping/falling.	3. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
	B) Mechanical hazards.	B) Make sure guards are in place and adequate, and that clothing fits snugly.
4. Check that tail pulley guard is in place, and that there is no build-up of material around tail pulley.	4. A) Slipping/falling.	4. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
	B) Mechanical hazards.	B) Visually check that guards are in place and adequate, and that clothing fits snugly. Do not touch any exposed moving parts. Report missing guards. For clean-up, use a long handled shovel in all areas, except where restricted clearance is a problem. This reduces possibility of coming in contact with moving parts. If a clean-up hopper is provided, shovel into hopper rather than directly onto belt.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
	C) Getting shovel caught in return idlers.	C) When shoveling onto moving conveyor, always shovel in the direction that the belt is traveling - the shovel and any material will be carried away from you if the shovel becomes hung in the belt.
	D) Striking co-workers.	D) Watch out for other people in the area.
	E) Back injuries.	E) While shoveling, move your feet when turning, rather than twisting your body. Lift with your legs, not your back. Load your shovel moderately.
	F) Caught between moving radial stacker and stationary object, if stacker begins to move.	F) When working near tail pulley of a radial stacker, do not position yourself between tail pulley and stationary object. If your conveyor system is equipped with an audible alarm, immediately move away from belt if alarm sounds.
5. Check if guard is in place at power drive that moves radial stacker. (Note to trainer: Omit if radial stacker is not used, and add what is used.)	5. A) Slipping/falling.	5. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
	B) Mechanical hazard.	B) If guard is not in place, do not touch drive. Report to supervisor, or replace guard by first locking out and tagging power to motor drive. Restore power after guard is replaced.
6. A) Visually check screens for problems with decks, "V" belts, leaking bearing seals, plugged spray bars, etc. Report any problems.	6. A) Slipping/falling.	6. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
	B) Mechanical hazards.	B) Visually check that guards are in place and adequate, and that clothing fits snugly. Do not touch any exposed moving parts. Report missing guards.
7. A) Inspect gear reducers at the conveyor head section.	7. A) Burned hand from hot reducers.	7. A) Visually check gear reducers to determine if there is any wobble in main shaft. Listen to determine if gear reducers are wobbling or making any other unusual noise. Report any problems.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
8. A) Visually inspect log washers (where used).	8. A) Slipping/falling.	8. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
	B) Mechanical hazards.	B) Visually check that guards are in place and adequate, and that clothing fits snugly. Do not touch any exposed moving parts. Report missing guards.
9. Inspect sand classifier (where used).	9. A) Slipping/falling from material spilled on walkway.	9. A) Check for material build-up where stations dump into splitting troughs. Clean spilled material with a water hose.
	B) Struck by whipping water hose. Slipping/falling while handling clean-up hose.	B) Secure hose against whipping by having a secure grip, standing on hose near nozzle, or using a helper. Turn water on slowly to a pressure at which you are able to walk.
	C) Electrocution.	C) Do not aim water at any electrical boxes.
	D) Eye injuries.	D) Wear eye protection. Be aware of others working in area.
	E) Bruises from water stream.	E) Do not aim water hose at another person.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
	F) Knocked into something.	F) Do not stand with your back toward open stairways, walkways, or moving equipment.
10. Inspect gear boxes at sand screws (where used). Listen for unusual noise in gear boxes, and report any problems to supervisor.	10. A) Slipping/falling.	10. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
11. Inspect rock crusher (where used), and clean up any spillage with a shovel and/or a water hose.	11. A) Slipping/falling from material spilled on walkway.	11. A) Use designated walkways, and keep them clean, and clear of stumbling hazards.
	B) Struck by whipping water hose. Slipping/falling while handling clean-up hose.	B) Secure hose against whipping by having a secure grip, standing on hose near nozzle, or using a helper. Turn water on slowly to a pressure at which you are able to walk.
	C) Electrocution.	C) Do not aim water at any electrical boxes.
	D) Eye injuries.	D) Wear eye protection. Be aware of others working in area.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
	E) Bruises from water stream.	E) Do not aim water hose at another person.
	F) Knocked into something.	F) Do not stand with your back toward open stairways, walkways, or moving equipment.
	G) Finger caught between pulley and belt.	G) Check that all "V" belt drives and couplings are guarded. Do not touch "V" belts. Report any missing guards to supervisor.
12. Return to work station. Listen for any unusual sounds while returning to work station. Periodically walk plant area, as called for by company policy.	12. A) Tripping/slipping hazards.	12. A) Watch step, and remove any tripping hazards while traveling to work station.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the sand, gravel, and crushed stone industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs"

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site, where the work will be done.

The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step - explaining the job to the employee - can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom, or a quiet office, for the first part of the training. Any general theory, or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.