Various Material Handling Systems in Foundry: A Review

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Abstract: Material handling has very old and vast history. In evaluation and implementation of material handling system, multiple factors should be considered, including the plant facilities, the machinery, the material handling equipment and of course people involved. In this paper the overall revive of principles of material handling systems and various material handling systems used in foundry is taken.

Keyword: Conveyor, Cranes, Industrial Trucks, Positioning Equipment’s.

I. INTRODUCTION

Each activity needs means of moving the material. Hence there is need of material handling and hence material handling equipment’s. Industrial material which is heavy and bulky, this cannot handle efficiently. That’s why we need material handling equipment’s. Any type of industry whether small or big, productions plant or process plant, agriculture industry or service sector in which such application there is only one common thing, movement of material, material handling.[1]

II. CLASSIFICATION OF MATERIAL HANDLING SYSTEM [2]

A. Equipment Oriented System

1. Convey system
2. Tractor transfer system
3. Fork lift truck
4. Industrial truck system
5. Underground system

B. Material Oriented System

1. Unit handling system
2. Bulk handling system
3. Liquid handling system

C. Method Oriented System

1. Manual systems
2. Automated system
3. Job shop handling system
4. Mass production system

D. Function Oriented System

1. Transportation systems
2. Conveying systems
3. Transferring systems
4. Elevating system

III. PRINCIPLES OF MATERIAL HANDLING

1. Orientation Principle: It encourages study of all available system relationships before moving towards preliminary planning. The study includes looking at existing methods, problems, etc.

2. Planning Principle: It establishes a plan which includes basic requirements, desirable alternates and planning for contingency.

3. Systems Principle: It integrates handling and storage activities, which is cost effective into integrated system design.

4. Unit Load Principle: Handle product in a unit load as large as possible

5. Space Utilization Principle: Encourage effective utilization of all the space available

6. Standardization Principle: It encourages standardization of handling methods and equipment.

7. Ergonomic Principle: It recognizes human capabilities and limitation by design effective handling equipment.


9. Ecology Principle: It encourages minimum impact upon the environment during material handling.

10. Mechanization Principle: It encourages mechanization of handling process wherever possible as to encourage efficiency.
11. **Flexibility Principle:** Encourages of methods and equipment which are possible to utilize in all types of condition.

12. **Simplification Principle:** Encourage simplification of methods and process by removing unnecessary movements.


14. **Safety Principle:** Encourages provision for safe handling equipment according to safety rules and regulation.

15. **Computerization Principle:** Encourages of computerization of material handling and storage systems.

16. **System Flow Principle:** Encourages integration of data flow with physical material flow.

17. **Layout Principle:** Encourages preparation of operational sequence of all systems available.

18. **Cost Principle:** Encourages cost benefit analysis of all solutions available.

19. **Maintenance Principle:** Encourages preparation of plan for preventive maintenance and scheduled repairs.

20. **Obsolescence Principle:** Encourage preparation of equipment policy as to enjoy appropriate economic advantage.[2][3]

**IV. VARIOUS MATERIAL HANDLING EQUIPMENTS**

**A. Conveyors**

Conveyors are used:

1. When material is to be moved frequently between specific points.
2. To move materials over a fixed path.
3. When there is a sufficient flow volume to justify the fixed conveyor investment.

Conveyors can be classified in different ways:

1. Type of product being handled: unitload or bulkload.
2. Location of the conveyor: in-floor, on-floor, or overhead.
3. Whether loads can accumulation the conveyor or no accumulations possible.

1. **Wheel Conveyor**

   Unit + On-Floor + Accumulate
   Uses a series of skate wheels mounted on a shaft (or axle).
   Spacing of the wheels is dependent on the load being transported.
   Slope for gravity movement depends on load weight.
   More economical than the roller conveyor. For light-duty applications Flexible, expandable mobile versions available.

   ![Figure 1: Wheel Conveyor](image)

2. **Roller Conveyor**

   Unit + On-Floor + Accumulate
   May be powered (or live) or non powered (or gravity).
   Materials must have a rigid riding surface.
   Minimum of three rollers must support smallest loads at all times.
   Tapered rollers on curves used to maintain load orientation.

   ![Figure 2: Roller Conveyor](image)

3. **Chain Conveyor**

   Unit + In-/On-Floor + No Accumulation
Uses one or more endless chains on which loads are carried directly
Parallel chain configuration used as (chain) pallet conveyor or as a pop-up device for sortation (see Sortation conveyor: Pop-up devices)
Vertical chain conveyor used for continuous high-frequency vertical transfers, where material on horizontal platforms attached to chain link (cf. vertical conveyor used for low-frequency intermittent transfers)

4. Magnetic belt conveyor
Bulk + On-Floor
A steel belt and either a magnetic slider bed or a magnetic pulley is used
To transport ferrous materials vertically, upside down, and around corners

5. Trolley conveyor
Unit + Overhead + No Accumulation
Uses a series of trolleys supported from or within an overhead track
Trolleys are equally spaced in a closed loop path and are suspended from a chain
Carriers are used to carry multiple units of product
Does not provide for accumulation
It is commonly used in processing, assembly, packaging, and storage operations. [5]

B. Cranes
General characteristics of cranes:
1. Used to move loads over variable (horizontal and vertical) paths within a restricted area
2. Used when there is insufficient (or intermittent) flow volume such that the use of a conveyor cannot be justified
3. Provide more flexibility in movement than conveyors
4. Provide less flexibility in movement than industrial trucks
5. Loads handled are more varied with respect to their shape and weight than those handled by a conveyor
6. Most cranes utilize hoists for vertical movement, although manipulators can be used if precise positioning of the load is required

1. Jib Crane
Horizontal boom (jib) supported from a stationary vertical support
Hoist can move along the jib and can be used for lifting
Operates like an arm in a work area, where it can function as a manipulator for positioning tasks
Jib can also be mounted on the wall
Arm can rotate up to 360

Figure 6: Jib Crane

2. Bridge Crane

Bridge mounted on tracks that are located on opposite walls of the facility
Enables three-dimensional handling
Top riding (heavier loads) or under hung (more versatile) versions of the crane
Under hung crane can transfer loads and interface with other MHS (e.g., monorail systems)

Figure 7: Bridge Crane

3. Gantry Crane

Single leg, double leg, and mobile types of gantry cranes Similar to a bridge crane except that it is floor supported at one or both ends instead of overhead (wall) supported

Figure 8: Gantry Crane

C. Industrial Trucks

1. Two-Wheeled Hand Truck
Load tilted during travel
Good for moving a load up or down stairways

Figure 9: Two Wheeled Hand Truck

2. Powered Pallet Jack
Pallet + Walk + No Stack + Powered
Powered lifting and/or travel
Powered pallet jack is sometimes referred to as a “(walkie) pallet truck”

Figure 10: Powered Pallet Jack
3. Counterbalanced (CB) Lift Truck
Pallet + Ride + Stack
Sometimes referred to as a “fork truck” (but other attachments besides forks can be used)
Weight of vehicle (and operator) behind the front wheels of truck counterbalances weight of the load (and weight of vehicle beyond front wheel s); front wheels act as fulcrum or pivot point
Rated capacity reduced for load centers greater than 24 in. and lift heights greater than 13 ft.
Workhorses of material handling because of their flexibility: indoor/outdoor operation over a variety of different surfaces; variety of load capacities available; and variety of attachments available—fork attachments can replace the forks (e.g., carton clamps) or enhance the capabilities of the forks (e.g., blades for slip-sheet’s)

2. Manipulator
Used for vertical and horizontal translation and rotation of loads
Acting as “muscle multipliers,” manipulators counterbalance the weight of a load so that an operator lifts a small portion (1%) of the load’s weight Can be powered manually, electrically, or pneumatically. Manipulator’s end-effectors’ can be equipped with mechanical grippers, vacuum grippers, electromechanical grippers, or other tooling
Manipulators fill the gap between hoists and industrial robots: they can be used for a wider range of positioning tasks than hoists and are more flexible than industrial robots due to their use of manual control

D. Positioning Equipments

1. Hoist
Used for vertical translation (i.e., lifting and lowering) of loads, Frequently attached to cranes and monorails to provide vertical translation capability Can be operated manually, electrically, or pneumatically, Uses chain or wire rope as its lifting medium.
Hoists are categorized into duty classes: H1—infrequent, standby duty uses (1 or 2 lifts per month); H2—light duty (avg. 75 start/stops per hour); H3—medium (max. 250 start/stops per hour); H4—heavy, and H5—severe duty.
3. Industrial Robot
Used in positioning to provide variable programmed motions of loads
“Intelligent” industrial robots utilize sensory information for complex control actions, as opposed to simple repetitive “pick-and-place” motions
Industrial robots also used for parts fabrication, inspection, and assembly tasks
Consists of a chain of several rigid links connected in series by revolute or prismatic joints with one end of the chain attached to a supporting base and the other end free and equipped with an end effector
Robot’s end effector can be equipped with mechanical grippers, vacuum grippers, electromechanical grippers, welding heads, paint spray heads, or any other tooling
Although similar in construction, an industrial robot is distinguished from a manipulator by the use of programmed control logic as opposed manual control
Pick-and-place industrial robots can be used as automatic palletizers
Mobile robots similar in construction to free-ranging AGVs
Can be powered manually, electrically, or pneumatically [4]

CONCLUSION
Different MHSs were considered and discussed. They were mentioned as theoretical, ultimate, and technologically workable. However, the suggestion was that companies should focus on and implement a MHS that is cost effective and is able to function at the present time without any obstacle and failure.
There are various principles and factors on which selection material handling system depends. By studying these parameters, selection of proper material handling system can done.

References