Study on Material Handling Systems

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Abstract— *now days in industries it is very necessary to use material handling system for to move material from one place to another place continuously to minimize operation time. Various conventional conveyor systems like belt conveyors, bucket elevators, screw conveyors, pneumatic and vibratory conveyors, and roller conveyor system are used in industry, like food, chemical, plastic, material processing industry. In our case, selected industry being run on small scale certainly have limitations to adopt these conventional material handling systems to convey the powders economically and precisely. In this paper we study different material handling system like: conveyor, automatic guided vehicle, robots, hydraulic and pneumatic material handling system etc.*

Keywords— Material Handling System, Small Scale Industry, Automated Guided Vehicle, Conveyor, Robots, Hydraulic and Pneumatic Material Handling System

I. INTRODUCTION

Handling involves the movement of materials from one place to another for the purpose of processing or storing. According to American Material Handling society,' Material Handling is an art and science of involving the movement, packing and storing of subsystems in any form. Thus material handling function includes all types of movements vertical, horizontal or combination of both and of all types of material fluid, semi fluid and discrete items and of movements required for packing and storing. The material handling function is considered as one of the most important activities of the production function as out of total time spent by the materials inside the plant area.

Material handling equipment are found to be flexible, modular and versatile. However, the failure of some of the installations, and the subsequent analysis of the reasons for failure, shows that careful design and operational planning of AGV-based material handling systems is required if the full potential of such a system is to be realized.

Material handling equipment are unmanned vehicles used to transport unit loads, large or small, from one location on the factory floor to another. These vehicles are operated with or without wire guidance and are controlled by a computer. A system controller is responsible for the regulation of traffic when more than one vehicle is in the system. Automated guided vehicle systems are computer controlled material-handling systems typically used for repetitive tasks in intermodal container terminals, distribution centers, storage and warehouses, manufacturing, and Assembly plants.

Among the new generation of material handling systems (MHSs), automated guided vehicles (AGVs) are the most widely used today in flexible manufacturing systems (FMS) and computer integrated manufacturing (CIM) environments.

AGV can be regarded as intelligent transportation system in the manufacturing environment. In this paper a literature review on AGV based material handling system is carried out with respect to some of the various factors such as throughput, unit load, Unit load, flow path design, throughput. This is the comprehensive review on some of the research of AGV based material handling to my knowledge. However no claim is made here that it includes all literature on AGVs. The scope of this survey has been mainly focused on results published in available research journals.

Material handling equipment is generally separated into four main categories: storage and handling equipment, engineered systems, industrial trucks, and bulk material handling.

II. TYPE OF MATERIAL HANDLING EQUIPMENT

The shop floor supervisor is the best agency to identify the potential areas of the application of low cost automated (LCA). Some of the low cost automated parts handling systems which are widely used in small and medium sized Enterprises (SME's) are explained below.

A. Conveyors

Conveyors are primarily horizontal-movement, fixed-path, constant speed material handling systems. However, they often contain inclined sections to change the elevation of the material.

Fig. 1: Conveyor

B. Portable Conveyors

Short length flat conveyors carried on a wheeled structure is termed portable conveyor. Portable conveyors are light in weight and compact in design and can easily move to desired places as we need.

Fig. 2: Portable Conveyor

C. Automatic Guided Vehicles

An automated guided vehicle system (AGVS) is a material handling system that uses independently operated, self-propelled vehicles guided along defined pathways. Today AGV's are competing with conveyors and other material handling system due to their advanced features like sensors, ability to take decisions, automatic path changing mechanisms etc.

Fig. 3: Automatic guided vehicles

D. Robots

Use of robots in industries is a common seen today albeit in SMEs. An industrial robot is an assemblage of links joined so that they can be articulated into desired positions by a reprogrammable controller and precision actuators to perform a variety of tasks like material transfer and inspection.

Fig. 4: Robots

E. Hydraulic Pallet Trucks

Pallet trucks are either motor operated or manual low-lift machines designed to raise loaded pallets sufficiently off the ground to enable the truck to transport the pallet horizontally. Pallet trucks are widely used material handling device and well known for its flexibility.

Fig. 5: Hydraulic Pallet Trucks

F. Hydraulic and Pneumatic Parts Handling Systems

The rapid development of electronic interfacing technology had seen the proliferation of electro-hydraulics and electropneumatics devices. Fluid, electric and solar powers are some of the energy technologies used for driving modern automated systems. Of these technologies fluid power is mainly reserved for traditional utilization. Hydraulic power is normally used in mechanisms and pneumatic power for sequential automated process.

Fig. 6: Hydraulic and pneumatic parts handling systems

III. LITERATURE REVIEW

A. Design Fabrication of Spring Operated Material Handling Equipment

According to industrial review the power which has been utilized for production out of which 32 to 35% of power is only utilized for material handling during the production which is unnecessarily wasted and hence the total cost of final product will increases. So if we want to decrease the total cost as well as the unnecessary power consumption either we have to reduce material handling or try for alternative handling. As the first option has several limitations we are trying for alternative handling system so are stepping towards a concept of potential energy of material to be handled as every material has its potential energy in the form of its weight.

Various studies have been made in different industries to indicate that the cost of handling alone accounts for about 20-25% for the total manufacturing cost.

B. Selection of Material Handling Equipment for Flexible Manufacturing System Using Fuzzy Analytical Hierarchical Process (FAHP)

In this paper an attempt has been made to select the most appropriate material handling equipment for the design and development of FMS. The proposed model has been build on the basis of material handling attributes and sub attributes which are critical for material handling equipment selection.

This paper predicts the material handling equipment to be selected for the purpose of material handling in FMS environment using fuzzy analytical hierarchical process (FAHP).

1) Fuzzy Analytic Hierarchy Process (FAHP) Method

In this paper Fuzzy AHP approach has been used for the evaluation of different material handling equipment's for the FMS environment under the given conditions. The example cited in the paper consists of 3 attributes along with 3 alternatives. This simple example has been presented for the demonstration of proposed methodology.

In this paper, a pair wise comparison was carried out between the various alternatives for each considered attribute and finally weights were obtained. These weights are then utilized for deciding the ranking of material handling equipments as A1 (Automatic Conveyor), A2 (Robot) and A3 (AGV). In the considered example, it is found that the material handling equipment A3 (AGV) is the best alternative among the considered alternatives.

The major limitations of FAHP are as follows:

- Pair wise comparisons are based on the expert opinions and this may lead to biasness.
- Application of Fuzzy AHP is inappropriate in general decision making.
- FAHP fails to capture the uncertainty in the operational environment.
- Decision is based on the comparison ratios. Moreover, uncertainties are used by the decision maker.
- Absolute values are not sufficient to make real life decisions.
- So, in future, following work may be carried out:
- More numbers of attributes can be identified for developing FAHP model.
- A comparison can also be executed with other fuzzy MCDM techniques like fuzzy TOPSIS approach which will be beneficial in enhancing the production and flexibility of the organization.
- Sensitivity analysis can be carried out to know the effect of different criterion on the material handling equipment selection.

C. AGV Based Material Handling System: A Literature Review

1) Literature on Unit load

Unit load size which may be defined as the number of distinct parts that can be aggregated and transported as a single unit by an AGV for processing in the shop. This quantity of parts to be handled at a time for each product type does significantly influence the operational efficiency of an AGV-based manufacturing system. P. J. Egbelu(1986) characterized AGV dispatching rules and also focused on selecting best unit load size in a flexible manufacturing system (FMS) using a procedure that is based on the application of mathematical programming, computer simulation, and statistics to minimize the total cost of manufacturing. B. Mahadevan & T. T. Narendran (1992) in their paper presented an integer programming formulation of the problem of finding the optimal unit load size. Using an analytical model to decide the number of AGVs required, an algorithm based on branching and implicit enumeration and a heuristic have been developed.

Also heuristic procedure has been developed for solving largesize problems. Unit load size is a major area of research as it significantly affects the productivity. The research work on unit load is to obtain best unit load size using tools of mathematical programming, heuristics and simulation. There is further need to use modern operation research or integration of methods that will help to be useful for major FMS types of industries to determine unit load.

D. Design Research on Hydraulic System of Working Device of a Forklift

In this paper, based on already the basic parameters of the push forward forklift in the market, the working device of the forklift has been introduced. And according to the calculation and checking, the main structural parameters of the lifting oil cylinder have been determined. The hydraulic system has been designed and calculated. The results of the paper have important practical significance to design of work device of the forklift.

As a kind of industrial vehicles, the current types of forklift are limited, it can't completely adapt to a variety of occasions. Most of the time, standard forklifts are only suitable for a particular occasion, in addition to these specific occasions; they may not very effective role. In this paper, based on already the basic parameters of the push forward forklift in the market, the working device of the forklift has been introduced. And according to the calculation and checking, the main structural parameters of the lifting oil cylinder have been determined. The results of the study have an important practical significance on meeting people's specific needs and improving the work efficiency, etc.

1) Guidance for Selection of Material Handling Equipment

IV. GUIDELINE FOR SELECTION OF MATERIAL HANDLING EQUIPMENT

- Define objective and specifications.
- Plan the process of handling with reference to available resources of MH in the market.
- Design shortest and less time consuming material flow lines.
- Take care of worker's capabilities and limitations.
- Ensure safety of human being.
- Limit the package size with reference to floor area.
- Use maximum vertically space for material handling
- Avoid bottlenecks.
- Use automated material handling systems.
- Select energy efficient and environment friendly MH equipment.
- Must be economical and easily operated.
- Low maintenance.
- Keep manual system ready along with MH systems.

Apart from above guide lines, the type of material to be handled also affects the packaging and handling system a lot. The physical state i.e. solid, liquid and gas, size i.e. dimensions, weight, shape and other characteristics like oily, brittle, humid, volatile, temperature also play an important role in selecting a MH system.

V. CONCLUSION

This study has put forward the various factors considered for the design and analysis of AGV based material handling system. The study revealed that there is need of further research on AGV based material handling. There is need for cross industry study to make the method suitable for all type of industries. It would be readily noticed that, with relatively low investments, LCA systems certainly enable the managements to lower the workers involvement in material handling. This automatically lowers the part rejections, improves safety and reduces accident rate, nurtures productive ambience and contributes significantly to product quality and organizational productivity.

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