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MULTIPURPOSE MATERIAL HANDLING AND LIFTING SYTEM

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Abstract – *- A vacuum is defined as "a state of emptiness that can be achieved by experiment". In practice, however, this state cannot be achieved. We therefore talk instead about a vacuum when the air pressure in a space is lower than the atmospheric pressure or when the density of air molecules is reduced. Furthermore, every space contains particles of matter such as protons and electrons, as well as zero-mass particles – photons – which transport energy at the speed of light. By use of this principal we can use vacuum for material handling purpose in the industry. We explain this system involving such activities as handling, storing, and controlling of materials. The word material has very broad meaning, covering all kind of materials, work in processes, subassemblies, and finished assemblies. The primary objective of using material handling system is to ensure that the material is delivered to the desire destination at right time and with minimum cost. The material handling equipment is not only designed to ensure the minimum cost but also meet to safety concern.*

Key Words: **vacuum, material, vacuum gripper, Material handling system, lifting system, Air pressure.**

1. INTRODUCTION

The vacuum lifter is a lifting device that by means of vacuum created by a vacuum generator, allows quick and easy-flexible grip and lifting of material. Maximum working times are reduced thanks to the use of the vacuum lifter. A sole operator is able to lift, handle, tilt or rotate the load quickly and safely. a vacuum lifters are designed and built offering greater safety to the operator and to the load. The use of improved materials and a series of components guarantee maximum grip safety. The vacuum lifters can be used in various industrial sectors. A wide range of hand-held or below-the-hook vacuum lifters are available for different uses, materials and surfaces with various power systems, dimensions and movement type.

The extensive range of vacuum component variants makes them ideal for use in many industrial applications. Sheet Handling is a challenging material handling problem; it's often bulky, heavy, and can be prone to damage if not handled correctly. Which is refers to why we offer a variety of vacuum sheet handling solutions which can be used in order to safely lift and move sheets made of a variety of materials. From heavy box handling to delicate glass maneuvering, vacuum lifters are the perfect material handling solution. Our vacuum lifting systems can be tailored for your application with custom settings for speed, precision or on power conservation designed to suit your needs. Vacuum lifters can pick up products ranging in size and shape helping to improve worker safety and efficiency. Vacuum lifters are often used to lift bags, boxes, plates, products, barrels, stackers, pallets and reels.

History of work:

The vacuum plays a vital role in research in the fields of chemistry, biology and physics. It is also indispensable in many industrial processes. In the rough vacuum range, the pressure gauges used are mainly mechanical, but some digital pressure gauges are also used. In the high and ultra-high vacuum range, highly sensitive pressure gauges are used. In all cases, it is recommended that you perform a test setup to determine the leak rate, thereby enabling you to ascertain which vacuum ejector you need.

Procedure: Determining the leak rate – Perform the test setup – Read the vacuum value achieved – Compare the result with the course of the curve in the 'Suction capacity as a function of vacuum.

Difference with respect to suction capacity = leak rate

Determining the correct ejector size – Intersection of the leak rate (now known) with the curves of other ejectors – Determine the attainable vacuum by means of projecting downwards from the intersections with the leak rate. Select the ejector that reaches the required vacuum level. Pressure is defined as the force per unit area. Air is a gas mixture made up of many particles (atoms and molecules). These particles are in continuous motion. Wherever they meet, they exert a force. The pressure and vacuum are measured by taking a specific unit area and measuring the number and intensity of this impact on this area. Measurements are necessary in order to be able to check and monitor processes. For this reason, all measuring instruments must be calibrated. For example: individual measuring instruments with the same function must be adjusted so that they produce the same result under the same conditions. In order to be able to evaluate or measure the vacuum medium, there are a number of items of technical equipment that are indispensable for applications in the fields of industry and research. Pressure gauges (vacuum gauges) are used generally as well as in the rough vacuum range. These gauges are scaled according to the level of accuracy required.

Pressure gauges work according to many different operating principles and can function mechanically or digitally.

1.1 Vacuum grippers

Vacuum grippers are used in the robots for grasping the non – ferrous objects. It uses vacuum cups as the gripping device, which is also commonly known as suction cups. This type of grippers will provide good handling if the objects are smooth, flat, and clean. It has only one surface for gripping the objects. The vacuum cup grippers operate using Bernoulli Principle for generating high-speed flow between the vaccsum cup and product surface thereby creating vacuum which lifted the product. Feasibility observations are studied to demonstrate and obtain an overall understanding on the capability and limitations of the vacuum cup gripper. Most of the robot grippers are not easily applicable due to the food products are often delicate, easily marked or bruised, adhesive and slippery.

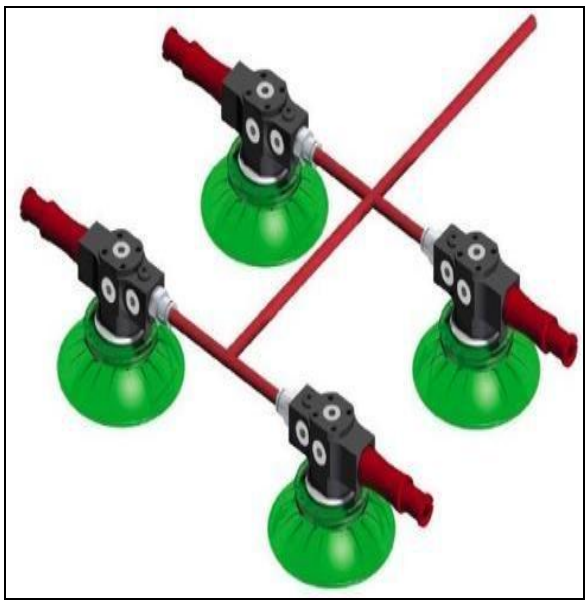


Fig 1: Vacuum grippers

1.2 TYPES OF VACCUM GRIPPERS

1) LEVEL COMPENSATOR:

A level compensator compensates for difference in level and absorbs shocks. The mounting also reduced the need for accurate positioning in height.

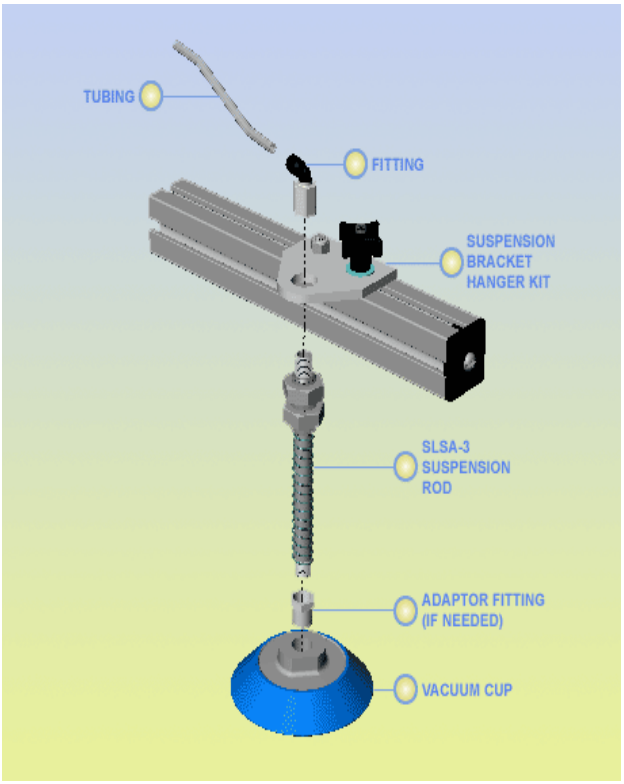


Fig 2: Level Compensator

2) Ball Joint:

A ball joint adjusts itself automatically to different contact angles and reduces the bending moments on the suction cup. The ball joint is uses for:

- For lifting heavy objects or plates
- For handling work pieces that are in motion.
- For handling work pieces that are curved or have irregular surfaces.

Fig 3: Ball Joint

1.3 Vacuum Grippers specification

Gripping Force: Generally up to 300lbs multiple cups can pick up to 6000lbs

Pressure require: -3 to -15 psi Gauge

Sizes: suction cup typically range between 0.5 to 18 inch diameters

Supporting technologies: Compressors, valve, air filters, Controllers

2. Vacuum cups:

Those object are generally work parts.Those are to be moved by the robot. These parts handling applications include machine loading and unloading, picking parts from a conveyor, and arranging parts onto a pallet. In addition to Work parts, other objects handled by robot Grippers include cartons, bottles, raw materials, And tools. The Single gripper is only one Grasping device is mounted on the robot's wrist.

A double gripper has two gripping devices Attached to the wrist and is used to handle two Separate objects. The two grasping devices can be actuated independently for single object. Grippers grasp and manipulate objects during the work cycle. Typically, the objects grasped are work parts that need to be loaded or unloaded from one station to another. Grippers May be custom-designed to suit the physical Specifications of the work parts they have to Grasp.

Vacuum-grippers become in suction cups, the suction cup is made of rubber. The suction Cups are connected through tubes with under Pressure devices for picking up items and for Releasing items air is pumped out into the Suction cups.

Fig 4: Vacuum cups

Vaccum grippers use suction cups as pick up devices. There are different types of suction cups and the cups are generally made of polyurethane or rubbers can be used temperature between -50˚C and 200˚C. The suction cup can be categorized into four different types; universal suction cups, flat suction cups with bars, suction cups with bellow and depth suction.

The universal suction cups are used for Flat or slightly arched surfaces. Universal Suction cups are one of the cheapest suction Cups in the market but there are several disadvantages with this type of suction cups. When the under pressure is too high, the suction cup decreases a lot which leads to a greater wear.

3. Blower:

Blower is equipment or a device which increases the velocity of air or gas when it is passed through equipped impellers. They are mainly used for flow of air/gas required for exhausting, aspirating, cooling, ventilating, conveying etc. Blower is also commonly known as Centrifugal Fans in industry. Blowers increase the pressure of the absorbed gas by a series of vortex motions formed by the centrifugal movement of the impeller. When the impeller is rotating, the channels in the impeller push the air forward by the centrifugal movement and a helical movement occurs.

Fig 5: Blower

3.1 BLOWER SPECIFICATION:

Inlet diameter: 38 mm
Outlet diameter (cyclone separator): 27 mm

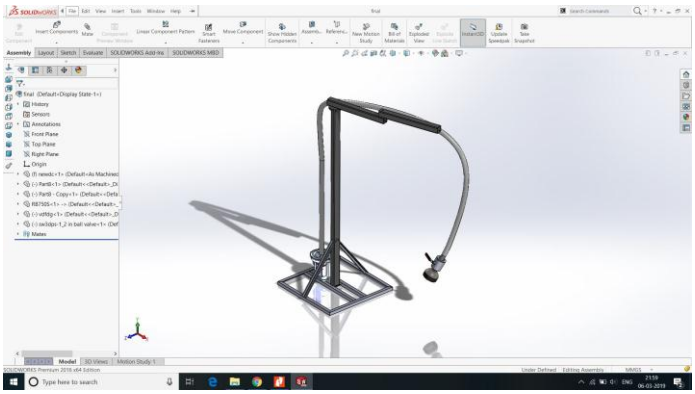
Product description:

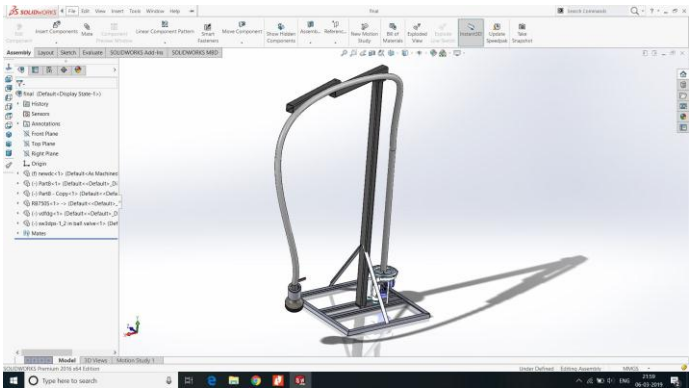
Power: 1.4 KW
240V A.C
Body material: Aluminium Alloy
Pressure: High Pressure

Power Source: Electric Blower
Fan speed: 0-5000 rpm

4. Design:

The design of experimental setup made by using solid works software:





Calculation:

MATERIAL HANDLING FORCE CALCULATION IN VERTICAL MOTION:

- F_{TH} = theoretical holding force [N]
- m = Weight [kg]
- g = Gravity [9.81 m/s²]
- a = Acceleration [m/s²] of the system
- S = Safety factor
- Our example:
- F_{TH} = 61.33 kg × (9.81 m/s² + 5 m/s²) × 1,5
- F_{TH} = 1,363 N

MATERIAL HANDLING FORCE CALCULATION IN HORIZONTAL MOTION:

- F_{TH} = m × (g + a / μ) × S
- F_{TH} = theoretical holding force [N]
- F_a = Acceleration force = m x a
- m = Weight [kg]
- g = Gravity [9.81 m/s²]
- a = Acceleration [m/s²] of the system (keep in mind Emergency Stop situations!)
- μ = Friction coefficient
- S = Safety
- Our example:
  F_{TH} = 61.33 kg × (9,81 m/s² + 5 m/s² / 0.5) x 1,5
- F_{TH} = 1,822 N

5. Methodology:

- Handling is a sub function of material flow and is subdivided into the areas of storing, changing quantities, moving, securing and checking.
- Handling requires the availability of specific geometric bodies
- Among the equipment used in handling technology are feed technology components and systems, pick-and place devices, manipulators and robots.
- The way in which parts are handled has a major influence on productivity in automated production and assembly processes today
- Vacuum technology is now an important part of this handling technology and has become indispensable in many of the industries and fields of application in which it is used. Vacuum technology has proven to be extremely effective in the handling of a wide variety of materials and parts and has thus opened up entirely new areas of application and solutions for handling technology.

6. EXPRIMENTAL SETUP:

Working steps:

Vacuum lifter with built in vacuum pump and it just needs to connect the compressed air hose. - operating pressure necessary is 6-7 bar - models with one or more suction pads with various dimensions and lifting capacity - available with fixed frame, with manual or pneumatic tilt, with rotation.

VACUUM BLOWER AC 110v/220v/400v (or other voltages on request) DC 12v or 24v to be used for example on self-propelled vehicles - with on board or independent electric vacuum pump - models with one or more suction pads with various dimensions and lifting capacity - available with fixed frame, with manual or pneumatic tilt, with rotation electric vacuum pumps with various capacities and voltages

In relation to the dimensions and consistency of the material to be handled, the lifters are made up of one, two, three, four or more suction pads. The suction pads can be rotated and adjusted both longitudinally and transversally with a practical hand wheels.

This way the lifter adapts better to the various dimensions of the material to be lifted. The pads have individual shutoffs and can be used singularly. Each pad has a vacuum entry cock positioned near to the operator controls with which is possible to close the flow of air and excluded the pad. The dimensions of the pad vary based on the weight and dimensions of the material to be lifted.

Standard vacuum lifters ranging from 80 to 2000kg. On request lifters are available lifters with inferior or superior lifting capacities. Our lifters with tilt are projected so that the lifting capacities declared, if not indicated differently, are equal for horizontal and vertical tilting. With vacuum blowers the gas particles (air) are forced to flow in the delivery direction through the application of additional force during evacuation. The main feature of these vacuum pumps is that only a relatively low vacuum can be generated. However, they do achieve very high flow rates (high suction capacity) at the same time. Vacuum blowers are categorized as suction blower. These vacuum generators operate according to the impulse principle, i.e. during the transfer of kinetic energy to the air by a rotating impeller 1, the air is drawn in and compressed 4 on the suction side 2 by the blades 3 on the impeller. 1 3 2 4 Vacuum compressors are another type of kinetic vacuum pump with similar features. The drawn-in air is compressed in the vane chambers of an impeller in multiple stages with low pulsation by means of centrifugal force. As with the blower, high suction rates can be achieved here with limited vacuum performance.

Simulation:

In general, the multi-stage ejector can, up to a pressure range of approx. 30% to 50% vacuum, generate this pressure faster or evacuate the volume faster than the single-stage ejector. However, a pressure of –0.4 to –0.8 bar or a vacuum of between 40 and 80% is normally required in practice.

Looking at the chart illustrating this comparison, it is obvious that single stage ejectors have a clear advantage over multi-stage ejectors in this case. The higher the vacuum level, the more time the multi-stage ejector takes to generate it.

Multi-stage ejectors have, on average, a much lower level of air consumption and thus consume less energy than single-stage ejectors, giving them a clear advantage over single-stage ejectors. However, if we look at this information in context with the evacuation time, the advantage is not so clear-cut. Although multi-stage ejectors have a lower level of air consumption, their evacuation time is higher. This considerably reduces the energy saving benefits.

Single-stage ejectors have a lower suction flow rate than ejectors based on the multi-stage principle. Multistage ejectors in the low vacuum range of approx. 30% to 50% can thus draw in higher volumes over the same amount of time.

However, as the vacuum level increases (from approx. 30 % to 50%), this progressive curve falls off rapidly for multi-stage ejectors. In other words, as pressure increases, the initial gains of a higher suction rate fall below the values achieved with single-stage ejectors.

Evacuation time = Time (s) required to generate a specific vacuum. Air consumption = Air consumption (l/min) of the ejector required to generate a specific vacuum.

These variables – evacuation time, air consumption and the volume dependent on the vacuum – produce a formula, which can be used to calculate the efficiency of a vacuum generator. This is the most objective criterion that can be used to assess the performance.

IMPLIMENTATION OF PROJECT:

Handling is a sub function of material flow and is subdivided into the areas of storing, changing quantities, moving, securing and checking. Handling requires the availability of specific geometric bodies (component parts or assemblies).

Among the equipment used in handling technology are feed technology components and systems, pick and place devices, manipulators and robots. The way in which parts are handled has a major influence on productivity in automated production and assembly processes today. Vacuum technology is now an important part of this handling technology and has become indispensable in many of the industries and fields of application in which it is used. Vacuum technology has proven to be extremely effective in the handling of a wide variety of materials and parts and has thus opened up entirely new areas of application and solutions for handling technology.

- Part feeding systems in the automotive industry
- Packaging industry
- Industrial robot applications in all sectors

• Process engineering
• Transport of liquids and bulk material.

RESULT ANALYSYS:

• Completely maintenance-free and wear-resistant because there are no moving parts

• Low initial costs

• Low energy costs, as the ejector is only switched on when in use

• No heat build-up Compact design, smallest possible dimensions

• Suitable for pulsed applications

• Fast reacting

• Small line lengths between vacuum generation and application

• Easy to install, can assume any mounting position

• Low weight

• Multiple functions possible in a single device

• Dry and filtered compressed air is useful

• Supply port 4 to 6 bar optimal.

Vacuum in handling technology means:

• Gentle handling of fragile parts

• Simple component and system design

• Compact, space-saving design

• Low weight, i.e. suitable for extremely dynamic movement

• Fast cycle times possible

• Low-cost

• Low maintenance costs

• Can be adapted to suit many requirements

Advantages and Disadvantages:

Multipurpose handling equipment is equipment used to transport, store or control material within various facilities. These facilities can include the manufacturing plants where the material is produced or the disposal sites where it ends up. Large material handling equipment includes cranes, trucks and lifts. Smaller equipment includes things such as storage bins, dollies and even cartons. The purpose of material handling equipment is to quickly, safely and more easily move material when compared with doing it manually.

Proposed system must be flexible enough to be economically and quickly adapted to the likely range of changes in the product or production techniques. If not, change over cost and time loss must be included in the evaluation, or it must be shown that the investment will be satisfactorily recovered before the proposed handling system will require modification.

Conclusion:

The comparison shows just how difficult it is to reach an objective conclusion about the both operating principles. And that's to say nothing of deciding on a preferred operating principle. Basically, the benefits of both principles lie in very specific areas and they justify their right to exist on this basis. It is also easy to see how minor technical adjustments affect the ejectors and how both operating principles can be optimized to suit the relevant application (e.g. by varying the level or receiver nozzle diameter). Both operating principles can thus achieve degrees of efficiency or possess attributes that defy any generalization. In conclusion, it can be said that the single-stage ejector achieves its best results in applications with average or higher pressure (vacuum). Safety risk a leakage flow increases the risk of the vacuum system no longer being able to attain the required pressure and the work piece being dropped during handling. Where there is a leakage flow the air consumption (energy consumption) of an ejector is much higher than that of a leak-proof system. Time a leakage flow means it takes longer to reach the required vacuum level.

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