Alternatives for the current lift-sliding doors used in cleanrooms

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Public summary

The need for controlled environments keeps growing. A cleanroom, defined by modern industrial standards, is a room in which the concentration of airborne particles is controlled, and which is constructed and used in a manner to minimize the introduction, generation, and retention of particles inside the room and in which other relevant parameters, e.g. temperature, humidity and pressure, are controlled as necessary [1]. Over the last 50 years, cleanrooms have evolved to maximize the control of air quality and to minimise contamination risks.

In order to achieve this, the areas on which dust can form must be reduced and the cleanroom must require as little maintenance as possible. Current cleanrooms often use sliding doors. A door panel is attached to two brackets with wheels that can slide along a rail to enable the door panel to move in front of and away from the door opening. A covering cap covers the mechanism, which is placed above the door opening. The problem with this mechanism is that dust can form on the cap, while the room must be as clean as possible.

Another problem with the current mechanism is that a high frictional force is produced in the mechanism. The diameter of the wheels that enable the sliding movement is often small, which translates into a higher working force, resulting in a greater inertia to system movement. A constant load is applied to the rollers. This results in wear on the rollers and a need for maintaining the system. During maintenance, the cleanroom gets infected and must be cleaned afterwards to meet the required air quality standards.

ColPro is a company that designs, manufactures and places sandwich panels. These sandwich panels, existing of two outer sheets of metal attached to a low density layer, are used in cleanrooms to provide the walls for cleanroom chambers. ColPro aims to explore alternative ways for the current lift-sliding doors that are used in cleanrooms. This thesis aims to explore implementing magnetism in the current mechanism, to reduce areas on which dust could form, decrease defects or reduce maintenance.

An academic approach is used to carry out the assignment. Firstly, the problem is broken down into smaller research questions and the strategies and methods that are used are defined. The problem is further explored using a product function analysis, where the interests of each stakeholder and the functions the product must fulfil are found. The current situation, the service that the current door manufacturer provides, and the technical features of the current door are analysed. A Failure Modes and Effects Analysis is performed to find the failure modes of the current door. A theoretical background is written about the techniques that are interesting for this project: magnetic levitation, magnetic propulsion, cleanrooms, and sliding doors. A market research is executed to explore the products that are currently available on the market, that could be interesting for or similar to this project.

One of the research objectives is finding out if it is possible to file a patent for a possible design outcome. To understand intellectual property, a summary is given on how patent application

works. Intellectual property landscaping is used to find patents that are relevant to the project. From this landscaping, it becomes clear that there are a few patents that can interfere with the project on a legal basis. The details of the inventions described in the patents are used as a basis for concept development.

Throughout the analysis and the intellectual property landscaping, some needs and wishes for an innovative cleanroom door arise. These are translated into design requirements. Also, some disadvantages and concerns for implementing magnetism in a lift-sliding door are concluded. These are taken into consideration for the feasibility of the project. Concepts for a possible design are brainstormed. All of these concepts have some drawbacks and raise major concern for the reliability of such a system.

The development of proceeding with this projects brings along many risks for ColPro. Using magnetism in a cleanroom door can be very unstable, unreliable and costly. Even if a reliable door system is manufactured, it needs to meet many requirements in order to compete with competitors. Furthermore, intellectual property laws can interfere with further development. It is advised to not continue with this idea.

Sources:

[1] V. Anghel and D. G. Chetwynd, "Creating a low-cost, ultra-clean environment," 2001.