

Principle, application and development trend of dry ice cleaning hub fixture

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Abstract—As an engineering technology, industrial cleaning plays an increasingly important role in industrial production; The development of the cleaning industry not only provides effective technical services for the whole society, but also has become an important symbol of today's social civilization. With the industrialization process of the country and the needs of social production and life, the application field of the cleaning industry is becoming more and more extensive. As an emerging technology, dry ice cleaning has the characteristics of high efficiency, wide application range and no pollution, and is widely used in mold, power electronics, petrochemical and automotive industries. Dry ice cleaning is an advanced and efficient industrial cleaning technology, which has advantages over other cleaning methods in terms of cleaning effect, cleaning applicability, and environmental protection.

1. Introduction

In the spraying process of the hub, will be sprayed on the tooling fixture, in order to avoid the tooling fixture to the hub secondary pollution, need to clean the tooling fixture, cleaning technology and people's production practice activities are closely related, with the continuous development of productivity level and social progress, cleaning technology has developed into a wide range, rich content of practical technology. Dry ice cleaning, also known as cold spray, is compressed air as the power and carrier, dry ice particles as accelerated particles, through the special jet cleaning machine sprayed to the surface of the cleaned object, so that the dirt, oil, residual impurities on the surface of the cleaned object quickly frozen, thereby condensation, embrittlement, peeling, and at the same time with the air flow removal. The nozzle is one of the key components of the entire dry ice cleaning device, and its structure and shape will have a great influence on the jet velocity, the shape of the jet and the flow field distribution of the gas. At the same time, the structure and type of nozzle are closely related to the efficiency of cleaning.

2. The principle of dry ice cleaning

According to the classification of cleaning methods and principles, cleaning technology can be divided into chemical cleaning, microbial cleaning and physical cleaning. Chemical cleaning is the use of chemical solvents to react with dirt or dissolve dirt, so that dirt detaches from the surface of the object; Microbial cleaning is a method of using microorganisms to decompose the dirt on the surface of objects and transform

them into non-toxic and harmless water-soluble substances; Physical cleaning is the use of mechanical force or energy to cause dirt to break, decompose and leave the surface of the object to achieve the effect of removing dirt. Commonly used physical cleaning methods are high-pressure water jet cleaning, ultrasonic cleaning, PIG cleaning, plasma cleaning, laser cleaning and dry ice cleaning.

Dry ice cleaning is an advanced and efficient industrial cleaning technology, in the cleaning effect, cleaning applicability, and environmental protection has other cleaning methods incomparable advantages, dry ice cleaning technology is the liquid carbon dioxide through the dry ice granulation mechanism into a certain specification of dry ice particles, made of dry ice particles into the dry refrigerator storage for backup. External compressed air is introduced into the dry ice blast cleaner, and the dry ice particles are sprayed to the surface of the cleaned object through the nozzle with the high-speed moving airflow, and the high-speed moving dry ice particles have a grinding and impact effect on the dirt layer. At the same time, dry ice particles with strong heat absorption ability are sprayed onto the surface of the cleaned object, so that the dirt layer cools down to embrittlement, the dirt layer and the contact material produce different shrinkage effects, reduce the adhesion of the dirt and the material surface, and the comprehensive effect makes the dirt removed, working principle: dry ice cleaning, also known as cold spray, is compressed air as the power and carrier, dry ice particles as the accelerated particles, through the special dry ice cleaning machine sprayed to the surface of the cleaned object, the use of high-speed moving solid dry ice particles momentum change, sublimation, Melting and other energy conversion, dry ice sprayed onto the surface of the cleaned object, the

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volume expansion nearly 800 times, so that the dirt, oil, residual impurities on the surface of the cleaned object quickly frozen, thereby condensing, embrittlement, being peeled off, and at the same time removed with the air flow. thus carrying dirt away from the surface of the object; It

will not cause any damage to the surface of the object being cleaned, especially the metal surface, and will not affect the finish of the metal surface. Figure 1 shows the dry ice cleaning diagram:



Figure 1 Dry ice cleaning diagram

3. Application of dry ice cleaning hub fixture

In the spraying process of the hub, it will be sprayed on the tooling fixture, in order to avoid the secondary pollution of the tooling fixture to the hub, the tooling fixture needs to be cleaned. Figure 2 shows the diagram of the hub fixture to be cleaned.

3.1 Dry ice cleaning fixture scene



Figure 2 Hub fixture diagram to be cleaned

3.2 Dry ice cleaning parameters

At this stage, the best cleaning parameters of dry ice

cleaning distance and cleaning angle are 18cm~24, 15°~25°, and Table 1 shows the physical property parameters of dry ice.

Table 1 Physical property parameters of dry ice

| Gas density | Liquid density | Solid density | Specific gravity | Boiling point |
|------------------------|----------------------|-----------------------|------------------|---------------|
| 1.977kg/m ³ | 1.030kg/L | 1572kg/m ³ | 1.53 | -78.45°C |
| Melting point | Critical temperature | Critical pressure | Evaporation heat | Hardness |
| -56.55°C | 31.05°C | 7.39MPa | 573.5kJ/kg | 1.5Mos |

3.3 Dry ice nozzle application

The nozzle is a key component in the dry ice blast cleaner, and the nozzle has an important influence on the cleaning effect. The type and structure of the nozzle affects the jet speed and the shape of the jet, etc., dry ice jet cleaning machine spraying dry ice particles and sandblasting machine spraying sand particles principle is similar, both use compressed air as power, so that the medium accelerates the ejection nozzle to impact the surface of the cleaned object. The nozzle of the dry ice blast cleaner has similarities with the nozzle of the sandblaster, so the nozzle design of the dry ice cleaning experimental device can learn from the nozzle used in the sandblasting machine in terms of structure and function, and through reviewing the previous research literature, the nozzles used in the current sandblasting machine mainly include straight cylinder nozzle, shrinkage nozzle, venturi nozzle and secondary air intake venturi nozzle. For dry ice cleaning of the hub fixture, you can choose a straight nozzle or a venturi nozzle.

Dry ice in the dry ice cleaning hub fixture has stability, that is, it avoids the possibility of flammable and explosive in other cleaning processes, and also reduces the pollution of the air, and at the same time uses industrial robots, using the flexible mechanism of industrial robots, with nozzles to spray the cleaned fixtures. Dry ice cleaning technology is to convert liquid carbon dioxide into certain specifications of dry ice particles through the dry ice granulation mechanism, and the dry ice particles made are stored in the dry refrigerator for backup. External compressed air is introduced into the dry ice blast cleaner, and the dry ice particles are sprayed to the surface of the cleaned object through the nozzle with the high-speed moving airflow, and the high-speed moving dry ice particles have a grinding and impact effect on the dirt layer. At the same time, dry ice particles with strong heat absorption capacity are sprayed onto the surface of the cleaned object, so that the dirt layer cools down to embrittlement, and the dirt layer produces different shrinkage effects with the contact material, reducing the adhesion between the dirt and the material surface, and the comprehensive effect makes the dirt removed. Figure 3 shows the spraying operation flow chart.

3.4 Dry ice cleaning hub fixture process

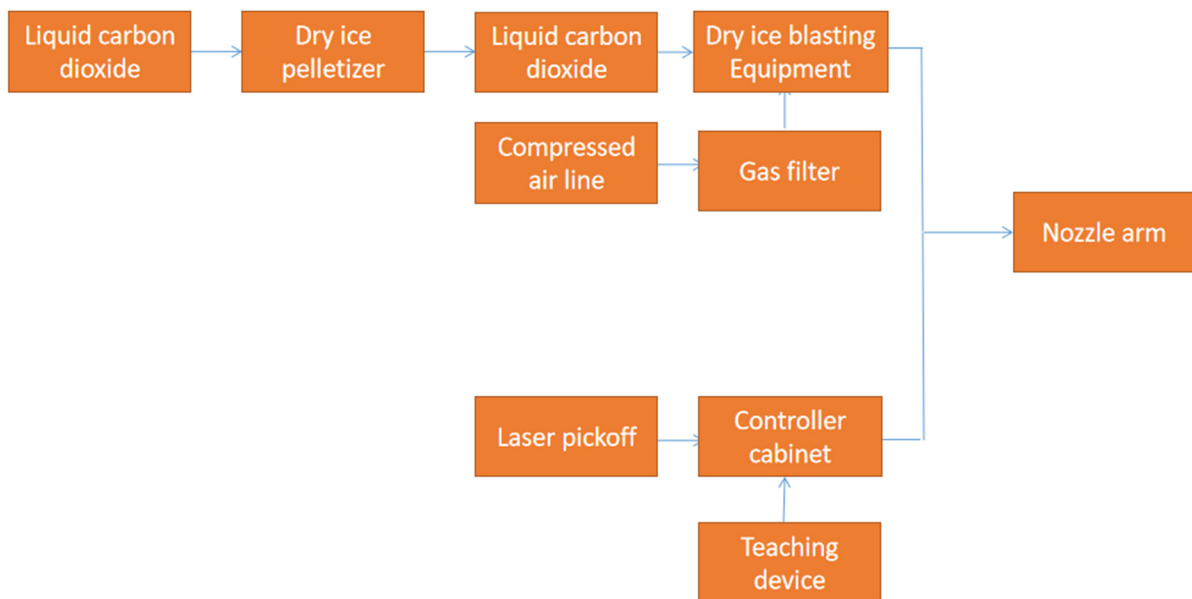


Figure 3 Spraying operation flow chart

4. Development trend of dry ice cleaning hub fixture

At present, the application field and cleaning performance of dry ice cleaning are constantly expanding, the characteristics of dry ice cleaning technology and environmental friendliness are also more and more attention, dry ice cleaning technology will be cleaning mechanism research, professional application optimization and equipment development has greater room for improvement, in the automotive mold industry can clean tire molds, rubber molds, injection molds, etc. In terms of industrial precision cleaning, dry ice cleaning technology performs well for cleaning optical lenses, silicon wafers, precision mechanical parts, etc. The above applications and research are the focus of the development of dry ice cleaning technology. To some extent. Extensive use of dry ice cleaning technology. It effectively reduces the equipment cost of production enterprises and gradually extends the service life and maintenance costs of production equipment. At the same time, it can also improve the overall product quality of Chinese enterprises, and then obtain good economic and environmental benefits. This further proves that dry ice cleaning is a more environmentally friendly and safe cleaning method.

5. Conclusion

In summary, dry ice cleaning technology is widely used in many fields such as automobiles, tires, electricity, printing and food production, and can play a unique role in all fields of society. In the process of dry ice cleaning wheel hub fixture has the advantages of non-destructive cleaning, online cleaning, waterless cleaning, environmental friendliness, etc., dry ice particles directly sublimated into carbon dioxide gas after dry ice cleaning, into the atmosphere, only the removed pollutants remain, easy to recycle, no secondary pollution, little environmental pollution.

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