

# A Study of the Real-Time Monitoring System for Chemical Logistics Based on Internet of Things

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**Abstract:** Compared with logistics of ordinary things, Chemical Logistics is flammable, explosive, toxic and corrosive and other characteristics. Storage and transport of specialty chemicals has inevitably brought a series of serious problems and potential problems because of its particularity, therefore, as opposed to general goods logistics, chemical logistics, safety management is very important. How to achieve transparency of chemical logistics process by using advanced technology, researchers and logistics operators are hoping to solve the problem. In this paper, the monitoring system based on Internet of things for chemical materials logistics is researched. Base on the monitoring system, the paper discussed not only the chemical logistics storage static environment during the real-time monitoring, but also the transport process of chemical products during the real-time monitoring. Application of the monitoring system, ensuring the safe operation of chemical logistics, has some positive significance.

**Keywords:** Internet of Things; Hazardous Chemicals Storage; Hazardous Chemicals Transport; ISO-TANK; Management Information System

## 1 Introduction

Compared with general logistics, chemical logistics is flammable, explosive, toxic and corrosive etc.. Chemical storage and chemical transportation are special. In the process of chemical storage and chemical transportation, a series of serious problems will be inevitably produced.

The remainder of this paper is organized as follows. First, the key issues and developments in the chemical industry are discussed. Second, the developments of Internet of Things are sum up. Third, visibility solutions are introduced to demonstrate their ability to manage chemical logistics and create value by improving customer satisfaction. The final section contains the concluding remarks.

## 2 Chemical Logistics Analysis

The chemical logistics is still in the initial stage of development in china. The market of hazardous chemicals logistics is not standardized. The facilities obsolete for dangerous goods logistics is older. The information level of chemical logistics is very low. The cost of chemical logistics operating is very high and the government controlling for chemical logistics is not enough and so on, so that hazardous chemicals in storage, transport process, serious accidents have occurred.

Our country many times fatal spill occurred in recent years, greater impact is in April 2004 in Chongqing chlorine gas leak and explosion, causing great losses. At that time, more than 100,000 residents in Chongqing

have an emergency evacuation. How to achieve the safe operation of chemical logistics, how to make chemical logistics transparent, is chemical logistics researchers and business personnel are eager to do. With the production and development of Internet of Things, it becomes possible for chemical logistics transparent<sup>[1-3]</sup>.

## 3 Applications of Internet of Things

The so-called "Internet of Things" (Internet of Things, IOT), is also known as sensor network refers to all kinds of information sensing device, which connect with the Internet and form an intelligent identification and manageable network. Similar with the Internet, the first application of sensor networks is in the military field. The late 80s and 90s, the U.S. military continued to establish a number of local sensor network, including the Navy's CEC program, FDS project and the Army's remote battlefield sensing systems. Held in 1999 in the United States, international conference on mobile computing and network proposed: the sensor networks are another development opportunities in the next century. In 2005, in Tunis, the World Summit on the Information Society (WSIS) on, ITU released the "ITU Internet Report 2005: Internet of Things", the "Internet of things" concept is formally proposed. In 2008, IBM made "smart Earth" strategy. In 2009, the EU announced the "Internet of Things plan of action". In 2009, Wen Premier proposed the establishment of "Experience China" centers. At the same time, China Mobile began to vigorously promote the Internet of Things applications. The development of Internet of Things began to accelerate in

the last two years.

Internet of Things can be divided into specific perception layer, network layer and application layer three levels: the perception layer is to identify the main object, to collect information, and including the two-dimensional code labels and readers, RFID tags and readers, camera, GPS, sensors, terminal, sensor networks; the network layer is mainly messaging and processing, and including the integration of communications and the Internet network, network management center, information center and intelligent processing centers; the application layer is the Internet of things and the depth of industry integration expertise, combined with the industry needs to achieve industry intelligence.

The problem that perception layer and the network of Internet of Things face is easy to solve. How Internet of things in the application of the relevant industries, in particular the application of networking technology to achieve chemical logistics property transparency, is the focus of this paper to explore<sup>[4]</sup>.

## 4 Applications of Internet of Things for Chemical Logistics

Rich content of chemical logistics, which include a: including chemicals packaging, storage, transportation, loading and unloading, etc.. Now part of most chemical companies are packaging companies to fulfill their own, while storage and transport links tend to outsourcing, in this article, we will pay more attention to the study the applications of Internet of Things in the chemical storage networking technology and transportation.

### 4.1 An Analysis of Internet of Things Using in Hazardous Chemical Material Storage

Enhance the safe storage of chemicals management, "Safe Production" and "dangerous chemical safety regulations" has specific provisions, and by enacting the "Common Rule for storage of hazardous chemicals", "flammable and explosive nature of goods storage and preservation, "" corrosive goods storage and preservation, "" toxic storage and preservation of goods "and other national standards. Despite these laws, regulations and national standards requirements, but how to manage the storage requirements of the organic integration, and safe operation, is still worth studying the application of technology.

During storage of hazardous chemicals, need to pay attention to several issues, including the requirements of the storage sites that must meet safety requirements in many ways; on the other hand, in the process of dangerous chemicals stored, the marks for the packaging of dangerous chemicals, there are strict requirements. The storage of hazardous chemicals should be clearly marked, signs should comply with relevant national standards. Meet the requirements of dangerous goods in bulk must

display warning signs that must comply with certain requirements, for the storage of dangerous chemicals arrangements and storage restrictions. Making arrangements for the storage of dangerous chemicals, the first should consider the relationship between them with the forbidden. Mutually incompatible materials on the chemicals commonly should be used isolation layer or from a distance, or in different rooms and storing. In addition, the case of fire, when heated, the event flows can cause fire, explosion or chemical reaction, producing toxic gases hazardous chemicals not in the open air or in damp, stagnant water in the storage building. Sunlight can occur by chemical reaction, causing fire, explosion, decomposition, compounds, or can produce toxic gases hazardous chemicals should be stored in a building, packaging, measures should be taken to dark.

These are just about the storage of dangerous chemicals, the management dangerous chemicals in the library during is also very important. In the process of dangerous chemicals stored, the conservation of hazardous chemicals should be involved, including chemical storage should be rigorous testing its quality, quantity, packing, with or without leakage. After storage of chemicals should take appropriate conservation measures, in the storage period, the regular inspection and found that the quality changes, packaging damage, leakage, shortage of stabilizer should be a timely manner. Warehouse temperature and humidity should be strictly controlled, regular checks and found that changes in time to adjust. At the same time, how to avoid the changing nature of hazardous chemicals, or leaking containers and leakage accident occurred, how to conduct a reaction of the fastest, according to the characteristic chemicals, chemical or physical methods of disposal of waste items may not be abandoned, polluting the environment etc., these must also be concerned about in the process of chemical storage.

In order to solve problems encountered in the process for Storage of hazardous chemicals, Internet of Things can be applied to objects on storage in real-time monitoring of chemicals. The real-time structure of monitoring is shown in Figure 1.

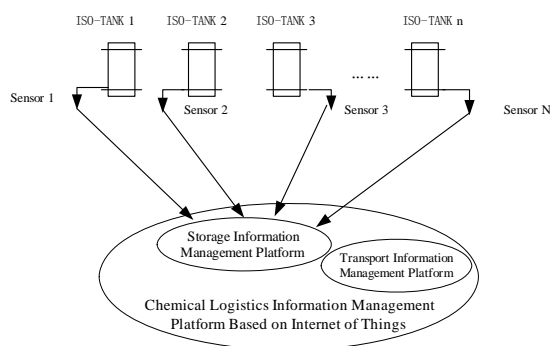


Figure 1. Storage Information Management Platform Based on Internet of Things

Above the storage networking technology based on material information management platform, including both traditional warehouse management information systems possess some of the daily management of information, including place of storage requirements, storage, identification, storage, and storage arrangements, send and receive storage of chemicals, storage and transportation conditions, ban with relations, information management, personnel training and management, conservation, waste and other information. At the same time, it is including standard-setting procedures, such as recognition of chemical safety regulations to be followed and standards; system maintenance and use; information inquiry process, storage of chemicals daily management procedures.

Meanwhile the above platform of information management, includes storage management, the most important part of that real-time monitoring of hazardous chemicals, container status, and the chemical container material temperature distribution, pressure and other information. By comparing the kind of basic physical properties of chemicals, dangerous chemicals in understanding what kind of state, if the temperature or pressure of chemicals in a pre-set a boundary value, the system automatically send alarm signals. Monitoring of chemicals in their own state of the same time, real-time monitoring of storage environment, if the external environment related indicators over pre-set safety value, the system automatically send warning signals.

Framework in Figure 1, can effectively solve the storage of hazardous chemicals the main problems encountered. In actual operation, the development of different chemical structure of the corresponding sensor is used to the bottlenecks encountered in dire need of engineering breakthroughs.

## 4.2 An Analysis of Internet of Things Using in Hazardous Chemical Material Transport

April 2006 the Office of the State Council Safety Committee issued "on the recent incidents of dangerous chemicals briefing," summed up the dangerous chemicals the main reason for traffic accidents and harm to the main problems include: severely overloaded transport vehicles, vehicle and vessel quality in poor condition; practitioners lack the necessary sense of security, illegal drive; carrier unit without qualification, illegal transportation; production, filling the illegal violation of enterprises; road transportation safety supervision lax, road control measures negative; event of an accident can not be timely and effective access to information; in the event of accident, delay or due to special circumstances people can not timely access to incident locations; unable to get the details of the delivery of goods; rescue measures are not effective.

From the above summary, we can see that inade-

quate information is the main problem for transport of dangerous chemicals. The factors causing the accident, a number of factors associated with poor information.

To solve this problem, as shown in Figure 2 can be constructed based Internet of Things for transportation information management platform. The information platform is not only with basic functionality for traditional transportation, while combined with the core technology of Internet of Things. Traditional Transportation Information Management Systems, focused on managing the transport vehicle condition, road transport of information, transport personnel information, as far as the transport of dangerous chemicals monitoring is not enough. It is difficult to find out whether the physical of dangerous chemicals changes or not with the external environment. Mentioned here not only refers to the external environment changes in the external operating environment, road bumps, the outside temperature, whether the moment of collision, dangerous chemicals and will likely affect the physical properties, packaging containers in leak case, the corresponding. Monitoring center find out the real-time status of hazardous chemicals through the Transportation Management Information System. It ensures that dangerous chemicals transportation is controllable by the external monitor to the combination of internal and external monitoring.

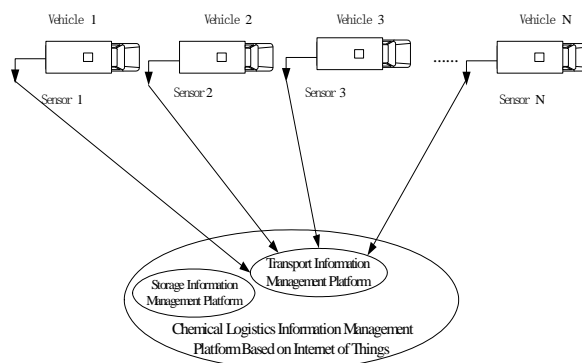


Figure 2. Transport Information Management Platform Based on Internet of Things

## 5 Conclusion

Compared to general logistics, the safety of chemical logistics is very important. For hazardous chemicals, either in the storage state, or in transit and how chemicals in real time to master the external environment in which the state and its chemical state, is a chemical logistics researchers and practitioners want chemical logistics solutions problem. The transport of dangerous chemicals and storage of hazardous chemicals in real time and effective monitoring is to solve the major chemical logis-

tics safety initiatives by using Internet of Things.

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