Brief Analysis of Development Situation of Policy and Technology Related to Oil Gas Recycling on Wharf in China

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Abstract. At present, China pays high attention to energy conservation and emission reduction work. Related departments have released a series of policy documents aiming at oil gas recycling on wharf, issued first batch of oil gas recycling pilot projects of crude oil and petroleum products on wharf and Technical Specification of Oil gas recycling Facilities Construction on Wharf. The paper introduces policy and technology situation about oil gas recycling on wharf, and proposes confronting problem of promoting oil gas recycling on wharf in China.

1. Introduction
Oil gas recycling on wharf includes the process of collecting oil vapour of ships, eradicating disorganized pollution discharge and restoring oil gas to gasoline after treatment of oil gas recycling equipment and pipeline transmission on wharf, which has good effect of energy conservation and emission reduction. Oil gas recycling on wharf has been carried out in developed countries such as Europe and America for almost 30 years, the technology and policy of which are relatively mature. In China, oil gas recycling on wharf starts late. Now, related research and pilot work have been conducted, and certain experience has been cultivated. Under the background of environmental protection across the country, it’s expected to enlarge implementation scope.

2. Development situation of oil gas recycling on wharf in China
Foreign countries have above 30 years of development experience for oil gas recycling on wharf. Related technology tends to be mature and equipment doesn’t need to be watched for 24 hours. Networking is realized between owners and equipment manufacturer to ensure real-time monitoring. With perfect laws, regulations and technical standard specification, sound monitoring and management system, discharge restriction is formulated aiming at different working conditions and gasoline, and requirements are provided for transformation of old wharf during transitional period.

China introduced oil gas recycling equipment technology during 2008 Olympic Games, which were applied by oil storage and gas stations in various cities such as Beijing, and the effect was good. However, oil gas recycling on wharf is seldom applied in ports and there’s few successful cases in China. At present, almost twenties of wharves in China have conducted oil gas (or chemical volatile gas) recycling work, including Aoshan in Zhoushan, Dalian, Tianjin, Huangdao in Qingdao, Yangzi in Nanjing, Jinling in Nanjing, Haiiao in Xiamen, Panyu in Guangdong, Jiantao in Nansha, Dongguan in Guangdong and Wanxiang in Zhoushan, etc. Two oil gas recycling facilities on wharf have been installed and in use, four trial run, while others are not put into use due to different problems such as security of equipment technology and ship supporting, which lead to waste of funds and resources.
Based on experience of ports and wharves with oil gas recycling facilities, a series of technology and policy problems during the process of constructing and applying oil gas recycling facilities need to be solved urgently.

To thoroughly research related technology and policy problems of oil gas recycling on wharf in China and propose suggestions to solve problems, Ministry of Transport confirms “pilot project of oil gas recycling for crude oil shipment of Sinochem Xingzhong” in “Notice about Releasing First Batch of Pilot Projects of Oil gas recycling on Wharf of Crude Oil and Petroleum Products by General Office of Ministry of Transport” (No. 136 [2016] Notice). This pilot project has been constructed well and put into trial operation in the end of 2017.

The pilot project installs oil gas recycling system on 1# and 2# wharf of Sinochem Xingzhong Oil Staging (Zhoushan) Co., Ltd in Aoshan, Zhoushan, which conducts recycling processing of vaporizing oil gas while shipping crude oil. This project belongs to reconstruction and extension project. Processing scale of oil gas recycling system is 5,000m³/h. Pilot contents include oil gas recycling process on wharf of sulfur crude oil, energy conservation and emission reduction way of oil gas recycling on wharf, renovation construction and trial operation management of wharf, safety management and acceptance, etc. After construction and operation of pilot projects, concentration of finally discharged NMHC is smaller than 10g/Nm³ and oil gas recycling rate exceeds 95% after handling through oil gas recycling system.

3. Current situation of related policies of oil gas recycling on wharf

3.1. Related policy documents of oil gas recycling on wharf in China

On Oct. 8, 2013, State Council issued Notice about Printing and Distributing Atmospheric Pollution Prevention and Control Plan, which set striving goal of governing atmospheric pollution, defined “promoting treatment of volatile organic compound” and “positively conducting oil gas recycling treatment on wharf of crude oil and petroleum products”.

In the Notice of Printing and Distributing Implementation Scheme of Overall Promotion of Energy Conservation and Emission Reduction of Water Transport in “The 12th Five-Year Plan” Period (No. 474 [2011] Notice) issued by Water Transport Bureau, Ministry of Transport, research on recycling and reusing of oil gas on wharf was listed as one of the five major demonstration and popularization projects of energy conservation and emission reduction during “The 12th Five-Year Plan” period. In September 2015, Ministry of Transport released Implementation Scheme of Specific Project of Pollution Prevention on Ships and Ports (2015-2020), which required “promoting oil gas recycling treatment on wharf of crude oil and petroleum products”. The specific time nodes were as below: before the end of 2015, release pilot scheme of oil gas recycling action on wharf of crude oil and petroleum products, conduct pilot work of oil gas recycling on wharf as per batch and category in major areas such as circum-Bohai-sea region, Yangtze River Delta region, Pearl River Delta region and main line of Yangtze River, etc. Before the end of 2017, steadily promote oil gas recycling on wharf of crude oil and petroleum products in coastal areas in China.

In July, 2015, Ministry of Transport issued the notice of “Printing and Distributing Implementation Scheme of Oil gas recycling Pilot Work on Wharf of Crude Oil and Petroleum Products by General Office of Ministry of Transport” (No. 474 [2015] Notice). In February, 2016, it issued Notice about Releasing First Batch of Pilot Projects of Oil gas recycling on Wharf of Crude Oil and Petroleum Products by General Office of Ministry of Transport” (No. 136 [2016] Notice).

3.2. Related specification standards of oil gas recycling on wharf in China

Now, State Environmental Protection Administration issues effective executive standards and specifications, including three national standards, namely Emission Standard of Atmospheric Pollutants of Oil Storage (GB20950-2007), Emission Standard of Atmospheric Pollutants of Gasoline Transport (GB20951-2007) and Emission Standard of Atmospheric Pollutants of Gas Station (GB20952-2007), etc. Petrochemical Department formulates multiple standard specifications such as
Technical Guide of Oil gas recycling System Engineering (Q/SH0117-2007) and Technical Specification of Acceptance Inspection of Atmospheric Pollution Control Project of Oil Storage and Gas Station (HJ/T431-2008), etc. According to above standards, emission limit of oil gas recycling equipment for NMHC is 25g/m³ and oil gas recycling rate is 95%. Beijing Environmental Protection Bureau also issues stipulation about local oil gas emission and emission limit of oil gas recycling equipment for NMHC is 20g/m³.

As per Emission Standard of Atmospheric Pollutants of Oil Storage (GB20950-2007), this standard applies to ship operation, but it only stipulates standard emission limit of oil gas. It doesn’t involve other highly volatile oils such as naphtha and crude oil, or explicitly define working condition of cargo oil shipment and specific sampling testing method. Therefore, Emission Standard of Atmospheric Pollutants of Oil Storage gets project approval for revision and it plans to include oil gas emission standard of crude oil while shipment, which will be issued in 2019. Once the standard is issued, it should be compulsorily executed and will promote oil gas recycling work on wharf.

With regard to oil gas recycling facility construction on wharf, China Academy of Transportation Science is entrusted by Water Transportation Bureau of Ministry of Transport to lead the compilation work of related specification standards such as Technical Specification of Oil gas recycling Facility Construction on Wharf and Ship-Shore Safety Interface of Oil gas recycling on Wharf, etc. Currently, Technical Specification of Oil gas recycling Facility Construction on Wharf has been issued and implemented, while Ship-Shore Safety Interface of Oil gas recycling on Wharf has been audited for approval.

4. Current situation of oil gas recycling technology on wharf

Oil gas recycling facilities on wharf are generally composed of ship pipeline system, ship-shore interface unit, pipeline transport unit, oil gas processing unit, oil gas recycling unit and general control unit.

1. Ship pipeline system: connect with ship directly, collect oil gas and air mixing gas discharged by central discharge outlet of ship.

2. Ship-shore interface unit: it’s safety control unit and conducts safety control of whole recycling process. In case of emergency, ship-shore interface unit can promptly cut off oil gas transmission and avoid expansion or spread of fire.

3. Pipeline transport unit: transport oil gas and air mixing gas to oil gas processing unit through ship-shore interface unit. This unit is usually equipped with pressure gauge, flow meter and pitometer to monitor the condition of oil gas transmission at any time.

4. Oil gas processing unit: it’s main unit of oil gas recycling system and major recycling steps are finished in this unit. There are multiple oil gas recycling crafts.

5. Oil gas recycling unit: it should be noted that only oil gas processing facility needed to be recycled will install this unit. If the wharf owner doesn’t have the plan of recycling oil gas, liquid oils from oil gas processing unit will be directly transmitted to oil tank through pipelines to mix with other oils or waited to be sold after transmitting to independent oil tank. At present, there are two common oil gas recycling ways, namely incineration and power generation.

6. General control unit: it’s commonly composed of PLC system and monitors whole oil gas recycling system. It receives the signal of each unit of oil gas recycling facilities and transmits to master control room on wharf or oil gas recycling equipment manufacturer. If any abnormal data, it gives command to halt or cut off specific valve, and it also alarms when the equipment is abnormal.

Oil gas processing unit is main unit of oil gas recycling system. As per basic principle, there are four kinds of oil gas recycling processing technology, namely condensation method, absorption method, adsorption method and membrane separation method. To realize better oil gas recycling, achieve energy-saving, economic and environmental goal, many compound techniques have appeared on the market such as condensation + adsorption method, silica gel + active carbon adsorption method and membrane + adsorption method, etc.
Apart from reducing investment, condensation + adsorption method can make up the shortcoming that it’s difficult for exhaust gas emission to reach standard after processing with condensation method. Besides, recycled liquid oils can be observed visually. The adsorption feature of silica gel + active carbon adsorption method is that silica gel is not spontaneously combustible. After filling silica gel and active carbon hierarchically in adsorption tank, active carbon won’t be spontaneously combustible. Compared to active carbon, silica gel is more suitable for disposing oil gas with high concentration. Consequently, most of the work requiring active carbon adopts silica gel. Active carbon has low-concentration processing feature, and shows purification function during final treatment process, which disposes exhaust gas emission more thoroughly and solves safety problem of active carbon. Membrane + adsorption method is relatively more mature and it’s generally applied on oil gas recycling market especially for oil gas recycling of petroleum products. As membrane craft only has screening effect and can’t realize vapour-liquid transition, adsorption method is required in later stage to realize vapour-liquid transition when processing petroleum products. Compared to membrane + condensation or compression method, membrane + adsorption method consumes relatively fewer auxiliary materials such as power consumption and freezing medium, while recycling rate is higher and treatment is more thorough.

Apart from making up the shortcomings of traditional technology, above compound technology has more effects such as promoting treatment efficiency, reducing floor space and reducing investment cost, etc. For example, above-mentioned solvent method with less effectively environmental emission can be qualified for working condition with large treatment work and reach the standard of emission when combing other technology. Furthermore, the equipment adopting compound oil gas recycling technology shows higher safety performance than traditional technology. At present, compound technology method is the trend of oil gas recycling technology design on wharf, but it requires further verification and research during current stage of oil gas recycling work on wharf in China.

5. Existing problems of oil gas recycling on wharf in China

Currently, many problems of policy and technology related to oil gas recycling on wharf need to be gradually solved in China.

(1) Benefit ownership problem after oil gas recycling: except enterprise wharves such as CNPC and Sinopec, oils transported by state-owned or privately-owned wharf companies are possessed by owner of cargo. The port only has transportation right of oils but not power of sale. Therefore, there are problems of property ownership and sales processing of oils exist after installing oil gas recycling equipment.

(2) Renovation problem of old wharves: energy conservation and emission reduction become national policy. The requirement of oil gas recycling on wharf is proposed in recent years, while most old wharves don’t reserve construction condition of installing oil gas recycling equipment. Different problems exist on old wharves such as limited floor space, no gas pipeline, no ship-shore connection safety unit, no gas transmission arm with emergency release system and no supporting auxiliary facilities, so the project of renovating and installing oil gas recycling equipment on old wharves is difficult.

(3) Imperfect ship supporting: oil gas recycling device is installed on wharf. The premise of recycling volatile oil gas during shipment is that ships are also installed with related oil gas recycling facilities. According to related materials, there are about 6,000 international oil tankers in China. Less than 500 tankers at above 20,000DWT engage in foreign trade route and they have oil gas recycling condition, while 90% of tankers at below 20,000DWT engage in domestic trade. Due to lack of compulsory regulatory requirements, these tankers are not installed with oil gas reception pipeline, standard connector or inert gas generation device, and they don’t possess oil gas recycling condition to realize collection of oil gas.

(4) Technology and safety of oil gas recycling facilities need to be improved: most of the wharves being installed with oil gas (or chemical volatile gas) recycling facilities have not been put into use due to insufficient technology and safety level of oil gas recycling. It’s essential to refer to advanced
experience in foreign countries, innovate and optimize technology and safety supporting based on features of wharf in China.

(5) Not mature cases and imperfect industry promotion: now, China has certain construction and using experience of oil gas recycling on wharf. Compared to European and American countries, specific cases are not mature to guide promotion of oil gas recycling in China. Oil gas recycling pilot project on wharf under construction is good support to thoroughly improve related policies and technology of oil gas recycling on wharf in China.

6. Conclusion

Further work of oil gas recycling on wharf in China involves many aspects. As an energy conservation and emission reduction project, how to promote it smoothly is major job contents for State Department of Environmental Conservation, Ministry of Transport, other related ministries and commissions. By relying on pilot project, how to make research on related policies and technology, solve existing technology and policy problems during oil gas recycling process on wharf to lay foundation for overall promotion of oil gas recycling on wharf is an urgent task.

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