Modern Physical Chemistry Research (2026)
Clausius Scientific Press, Canada

DOI: 10.23977/mpcr.2026.060104
ISSN 2616-1702 Vol. 6 Num. 1

Application Research of Hydrocarbon Cleaning

Zitao Song

Shanghai Weiyu International School, Shanghai, 200231, China

Keywords: Hydrocarbon; Cleaning; Rust Prevention; Environmental Protection; Safety

Abstract: In recent years, with the accelerated phase-out of ODS in China and the government's emphasis on environmental protection and workers' health, environmentally friendly hydrocarbon cleaning technology has been increasingly applied in industrial production. In the future, hydrocarbon cleaning will become the mainstream of China's cleaning industry due to its advantages of high efficiency, low toxicity, cost-effectiveness, and environmental friendliness. The water-based cleaning products currently adopted by Company H feature high consumption, elevated costs and substantial emissions. Amid increasingly stringent environmental regulations, further promotion of their application is not viable. Accordingly, Company H has initiated research and study on hydrocarbon cleaning technology.By comparing its existing equipment and processes with specialized hydrocarbon cleaning equipment and workflows, the company has evaluated various hydrocarbon cleaning products to assess their practical performance. The ultimate goal is to select a product that delivers satisfactory cleaning and rust prevention performance while fully complying with environmental protection standards.

1. Introduction

1.1 Research Background

Company H has always used water-soluble cleaning agents and rust preventatives for part cleaning. After a long time of use, the tank solution will become dirty and old; therefore, it is necessary to regularly drain the old solution and add new chemicals to maintain a good state of cleaning performance and high-quality cleaning. As a result, the traditional way has produced a large amount of industrial wastewater. To improve the quality of cleaning and save water resources and reduce the discharge of polluted water, Company H has introduced green hydrocarbon cleaning technology in its production[1].

1.2 Research Process

First, systematic study was carried out on the principle and process of hydrocarbon cleaning technology, and some preliminary process verification tests have been completed. Therefore, hydrocarbon cleaning was formally used for the cleaning work of mechanical parts. Through this research, we have obtained the applicable range of the process, optimal process parameters and the actual cleaning effect for different types of surface dirt and material characteristics of cleaned workpieces.

1.3 Research Object

Cleaning Process of Small Parts of Company H Before Assembly

1.4 Research Goals

The aim of this study is to verify whether the application of hydrocarbon cleaning technology in Company H can enhance the quality of surface cleaning for workpieces, reduce enterprise water consumption and wastewater discharge, and thereby achieve the production objectives of energy saving, emission reduction and green development.

2. Hydrocarbon Cleaning Tests

Hydrocarbon cleaning agents are mainly for the removal of oil stains. Therefore, all the test workpieces selected in this experiment are machined parts with surface oily dirt that are in line with the actual production working conditions.

2.1 Cleaning Tests

2.1.1 Test on Malaysian Delichem Hydrocarbon Cleaning Equipment

To determine whether the parameters of the hydrocarbon cleaning process meet the current requirements of the enterprise for particulate residue and oil residue in parts, several groups of comparative tests were conducted under different process conditions, and professional tests and data analysis were carried out on the particulate content and oil content of workpieces after cleaning[2]. Below “table 1” is the test data of Malaysian Delichem Hydrocarbon Cleaning Equipment:

Table 1: Delichem Hydrocarbon Cleaning Equipment test data

Number of Workpieces	Cleaning Process	Particulate Content (mg/pc)	Average Particulate Content (mg/pc, 5 pcs)	Oil Content (mg/pc)	Average Oil Content (mg/pc, 5 pcs)
2 pcs	4min ×3 tanks	0	0.28	43.75	86.48
3 pcs	4min ×3 tanks	0.47		114.97	
2 pcs	4min ×4 tanks	0.4	0.44	38.35	25.9
3 pcs	4min ×4 tanks	0.47		17.6	
2 pcs	3min ×3 tanks	0.7	0.8	34.8	40.14
3 pcs	3min ×3 tanks	0.87		43.7	
2 pcs	3min ×4 tanks	1.1	0.7	17.6	27.64
3 pcs	3min ×4 tanks	0.43		34.33	

According to the first set of test results, after hydrocarbon cleaning, the particulate residue on the rotor is in the qualified range; as for the cleaning effect under different conditions, a longer cleaning time of 4 minutes also reduces the amount of particulate matter[3]. However, the oil residue of the workpieces after cleaning was much higher than the standard. Based on the analysis, it was

determined that the lack of a good drying function in the test equipment may be the reason for remaining oil on the workpiece. To find the reason for this problem, some additional tests were carried out on the standard workpieces from the manufacturer. At the same time, a comparison test was also carried out with the untreated rotor and with the rotor that has been treated by traditional comprehensive cleaning to remove particles and oil[4-5]. Below“table 2”is the test data of Particulate and Oil Content After Hydrocarbon Cleaning:

Table 2: Test Data of Particulate and Oil Content After Hydrocarbon Cleaning

Process	Particulate Content (mg/group)	Particulate Content (mg/pc)	Oil Content (mg/group)	Oil Content (mg/pc)
Unwashed (3 pcs)	4.5	1.5	80.54	26.85
Comprehensive Cleaning (3 pcs)	2.4	0.8	39.73	13.24
Hydrocarbon Cleaning 1 (3 pcs)	0.2	0.07	36.80	12.27
Hydrocarbon Cleaning 2 (3 pcs)	0.4	0.13	35.14	11.71

After washing and drying with hydrocarbon in the second round of tests, the parts have been fully dried. According to the test results, the amount of dust in the workpieces after hydrocarbon cleaning was much lower than that after traditional comprehensive cleaning, and although slightly lower than in the old way, it had reached a good standard.

2.1.2 Tests on Japanese Showa Hydrocarbon Cleaning Equipment

The table 3 contained the data of rotor components achieved firstly as below.

Table 3: Japanese Showa Hydrocarbon Cleaning Equipment First Test data

	State	Oil Concentration (ppm)	Particulate Content (mg)	N Count
A	Before Cleaning	0.045	5.8	1
A	After Cleaning	0.000	0.7	1
B	Before Cleaning	0.280	9.4	1
B	After Cleaning	0.160	1.3	1

The table 4 contained the data of rotor and mufflers achieved secondly as below.

Table 4: Japanese Showa Hydrocarbon Cleaning Equipment Second Test data

Parts		State	Oil Concentration (ppm)	Particulate Content (mg)
rotor 1	Before Cleaning	0.280	2.4	2
	After Comprehensive Cleaning	0.130	1.8	3
	After Hydrocarbon Cleaning	0.027	0.83	3
rotor 2	Before Cleaning	0.885	7.25	2
	After Comprehensive Cleaning	0.750	3.75	2
	After Hydrocarbon Cleaning	0.266	1.65	2
Muffler 1	Before Cleaning	0.015	0.75	2
	After Comprehensive Cleaning	0.000	0.13	3
	After Hydrocarbon Cleaning	0.000	0.13	3
rotor 3	Before Cleaning	0.000	9.10	2
	After Comprehensive Cleaning	0.000	5.70	2
	After Hydrocarbon Cleaning	0.000	4.05	2

The test data show that the hydrocarbon cleaning technology can reduce both the amount of dust and oil on the surface of workpieces to a certain extent and has good cleaning performance; therefore, it is expected to be better than that of the traditional multi-functional cleaner.

2.2 Rust Prevention Tests

The cleaned workpieces need to go through a few links, such as turnover and stacking, before the next assembly, so they should have good rust resistance after cleaning and follow a standard rust-prevention cycle of one week. To see if the hydrocarbon cleaning agent can reduce rust, some rust-prevention tests have been carried out on rotor workpieces that will be used as test specimens.

The four A-series rotors were manually divided into two groups, and then each group was put in one of the two kinds of hydrocarbon cleaning agents for 5 minutes. After submersion, the workpieces were taken out of the immersion tank and then left alone for a long time to see if there was any surface rust.

In the past three months of continuous observation, there have been no rust spots on the surface of any of the test workpieces. The following figure 1 and figure 2 showed different cleaning agents as AHC-33P and AHC-04. Although the rust-prevention effect will be partially affected by the storage environment, according to the test results, it has shown excellent and stable rust-prevention performance for hydrocarbon cleaning agents and can meet the production and storage requirements of enterprise parts.

Figure 1: Rotor after cleaning with hydrocarbon agent (AHC-33P)

Figure 2: Rotor after cleaning with hydrocarbon agent (AHC-04)

3. Environmental Assessment

All-round environmental benefit assessment of the change in the old water-based cleaning method to hydrocarbon cleaning technology at Company H will be carried out in this chapter.

3.1 Hydrocarbon Cleaning Agent

The table 5 indicated the performances of NS-100 hydrocarbon cleaning agent in this test as below.

Table 5: NS-100 hydrocarbon cleaning test data

Performance Index	Parameter
Density (15℃) (g/cm³)	0.734
Boiling Point (℃)	171
Specific Heat (20℃) (kcal/kg·K)	0.52
Latent Heat of Vaporization (J/g)	275.9
Flash Point (℃) (TAG)	53(TAG)
Lower Explosion Limit (vol%)	0.8
Upper Explosion Limit (vol%)	5.5
Fire Protection Classification (Category 4 Hazardous Substances)	Class 2 Petroleum
Acute Oral Toxicity LD50 (g/kg)	>15

The first solvent cleaning agents that were used were trichloroethylene and dichloromethane; they are toxic to human health and harmful to the environment, and trichloroethane can also damage the ozone layer in the atmosphere. On the other hand, the NS-100 hydrocarbon cleaning agent used in this project is an environmentally friendly product that does not harm people's health, is safe for the environment, and will not damage the ozone layer in the atmosphere.

3.2 Comparison of Hydrocarbon and Conventional Water-Based Cleaning Agents

The main reason that hydrocarbon cleaning technology is not as high as traditional water-based cleaning is its lack of water. It does not need to use desalinated water and will not generate cleaning wastewater; thus, there will be less pollution from the industry and green cleaning production can be achieved.

According to the production data in table 6 of the company, one old-style, all-purpose wet cleaning machine will produce about 1,743 tons of cleaning wastewater annually under normal operation:

Table 6: Disposal Data of Three Wastes

Waste Discharge Type	Water-Based Cleaning (Single Comprehensive Cleaning Machine)	Hydrocarbon Cleaning	Disposal Method
Wastewater	1743 tons/year (concentrated wastewater), steam condensate (dilute wastewater)	No discharge	Discharged to special wastewater treatment pipeline
Solid Waste	Residue, metal scraps, waste oil	Residue, metal scraps, waste oil	Centralized collection and unified harmless treatment
Waste Gas	Humid gas	Humid gas	Discharged outdoors through exhaust fans

4. Conclusion

Overall, the application performance of hydrocarbon cleaning technology and related cleaning agents at Company H is good. To solve the problem of oily contamination on the surface of machined parts, this technology can improve the cleaning efficiency of workpieces and reduce pollution caused by residual oil. At the same time, it can also save production water resources and eliminate the problem of annual wastewater discharge by the enterprise to a certain extent. It is an

energy-saving, low-pollution and environmentally friendly industrial cleaning technology that can meet the production needs of the enterprise for energy saving, emission reduction and green development, and is popular and applicable.

References

[1] Wu Yong, Xue Xuzhi. Eco-friendly Hydrocarbon Cleaning Technology and Its Application in the Heat Treatment Industry[J]. Cleaning World, 2024, 40(12): 39-41

[2] Yang Jianan, Guo Jianfeng, Yan Yuanyuan, et al. Research on the Application of a Novel Ultrasonic Cleaning Device and Eco-Friendly Cleaning Agent[J]. Science and Technology Wind, 2019, (20):10

[3] Shao Jianying, Zhao Kunming, Kang Chao. Ultrasonic Hydrocarbon Vacuum Cleaning Technology and Application[J]. Cleaning World, 2015, 31 (7): 24-27

[4] Chen Kangzong, Li Zhongde. Research, Application, and Prospects of Hydrocarbon/Vacuum Cleaning Technology (Part II) [J]. Cleaning World, 2005, (3): 20-23

[5] Zhou Zhirun. Hydrocarbon Cleaning Agents and Their Cleaning Equipment[J]. Cleaning Technology, 2004, (10):42-51