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Environmental Impact Assessment of New Energy Batteries

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Abstract

At present, the world's environmental problems are becoming more and more serious, which is also highly valued by leaders all over the world, and environmental impact assessment is also frequently mentioned. Because environmental impact assessment can promote the construction of ecological society, let more people participate in the protection of the environment and form the subjective consciousness of caring for the environment. China's rapid economic development has inevitably brought many problems, one of which is environmental problems. At present, the main problems are low public participation, information distortion and difficult to reach opinions, which not only affects social stability, but also causes great losses to sustainable economic development. At present, new energy vehicles have been fully developed in China. It is of great practical significance to fully analyze the impact of battery plants on the environment.

Keywords

Battery factory; Environmental effect; Assess; New energy

1. Introduction

This paper investigates the potential environmental impacts of using electric vehicle (EV) batteries as energy storage. Electrifying the transportation sector is an inevitable step towards a more sustainable energy system to address climate change mitigation. The large-scale deployment of electric vehicles increases electricity demand while providing an opportunity to consolidate the use of EV batteries to shift peak demand to retired EV batteries through vehicle-to-grid, battery swapping, and reuse. The environmental consequences of using EV batteries as energy storage are analyzed in the context of a 2050 energy scenario. The results show that using an EV battery for energy storage via battery swapping helps reduce the investigated environmental psychological impact; this can be further reduced by using retired EV batteries. This paper also includes a series of investigations conducted on a lithium-ion battery manufacturer to further investigate the environmental impact of its production processes.

2. Pollution Source Analysis and Corresponding Measures

2.1 Sources of Air Pollution and Treatment Measures

2.1.1 The ingredients contain dust and exhaust gas

During the batching process, lithium iron phosphate, lithium manganese oxide or lithium cobalt oxide, carbon black, and graphite are added, generating a small amount of dust. The data is as follows: dust generation is 0.7t /a, and based on a 70% settling rate in the workshop, the emission is 0.21t /a (0.044kg /h). The above data are estimated based on the raw material usage of the project.

Note: The article was originally published in *Scientific Development Research*, and this is an authorized translation of it.

2.1.2 NMP exhaust gas

During the positive electrode baking and drying process, some NMP volatilizes, generating organic waste gas containing NMP. The equipment is equipped with an NMP condensation and recovery device and activated carbon adsorption. After treatment, the waste gas is discharged through a 15m exhaust stack, removing 96% of the gas. The waste disposal system has an air volume of 3000 m^3 /h, and a single production line can generate high-concentration waste gas. After treatment, this figure is reduced from 2068.57 mg / m^3 to 73.78 mg / m^3, and the emission rate meets the emission standards.

The coating machine's baking system is well-sealed, resulting in very low fugitive emissions. Based on an estimate of 3‰ of the material quantity, the fugitive NMP emissions are 1.3 t /a.

2.1.3 Vacuum pump exhaust gas

During the operation of a vacuum pump, the temperature rise causes the pump oil in the vacuum pump to evaporate rapidly. The evaporated gas is an organic waste. The main pollutant of this waste gas is total methane hydrocarbons. However, because the concentration of non-methane produced is relatively low, it can be discharged through a 1.5 m exhaust stack.

In a single vacuum pump, the system air volume is approximately 252 m^3 /h. According to the test results, the concentration of non-methane total hydrocarbons produced is 1.38 mg / m^3, and the rate is 0.0003 kg /h. The emissions meet the emission standards.

2.1.4 Vacuum pump exhaust gas

When the vacuum pump is running, the pump temperature rises, causing a small amount of vacuum pump oil to evaporate, which is an organic waste gas. The main pollutant is non-methane total hydrocarbons. Since the concentration of non-methane is very low, it is directly discharged through the matching 15m exhaust stack.

The single vacuum pump system has an air volume of 300 m^3 /h. The concentration of non-methane total hydrocarbons produced is 5.05 mg / m^3, comparable to similar equipment in China. The production rate is 0.0015 kg /h. Direct emissions meet the secondary standard for non-methane total hydrocarbons in Table 2 of the "Integrated Emission Standard of Air Pollutants" (GB16297-1996).

2.1.5 Electrolyte injection waste gas

The organic gases in the electrolyte act as organic solvents, primarily serving to seal the electrolyte. Lithium-ion battery electrolytes contain components such as diethyl carbonate (DEC) and lithium hexafluorophosphate. Waste gas is generated during the secondary lithium-ion battery production process. Because the operation mainly uses fully automated, closed-loop liquid injection machines, only a small amount of organic waste gas is released.

2.1.6 Oil fumes

If the canteen has stoves that use electricity as an energy source, the fumes produced during cooking need to meet relevant standards. First, they need to be collected by exhaust hoods, and second, they need to be purified by fume purification facilities. Only after these two steps are completed can the fumes be discharged.

By analogy, the concentration of oily fumes is estimated to be around 15 mg / m^3. A combined oil fume purification unit is proposed to treat the fumes, achieving a purification efficiency of over 90%, an emission concentration of 1.5 mg / m^3, and an exhaust volume of 10,000 m^3 /h. This meets the minimum removal efficiency of 75% for medium-sized oil fume purification facilities as stipulated in GB18483-2001. After treatment, the oily fumes will meet the emission standards, which are 2.0 mg / m^3.

2.2 Wastewater Pollution Sources and Treatment Measures

The sources of wastewater are numerous, mainly including wastewater that may be generated in the NMP exhaust gas heat exchange and cooling system, domestic wastewater, and agitator cleaning wastewater.

During the production and operation process in the factory area, the generation of negative electrode slurry and wastewater in the mixing tank is unavoidable. In this case, the wastewater must first be treated by sedimentation before being discharged. This is because these wastewaters may contain pollutants such as COD and SS in the form of graphite, styrene-butadiene rubber, and sodium carboxymethyl cellulose.

The NMP wastewater, which are COD and SS, will decrease after treatment, with a production rate of

approximately 0.9 m3 /d.

Wastewater generation is unavoidable during the pure water production process. After the wastewater is generated, it is discharged through the factory's drainage network and then through an integrated wastewater treatment process.

Domestic sewage is widely present in the factory's office buildings, sanitary facilities, dormitories, and workshops. Its main pollutants are COD, ammonia nitrogen, and SS.

Wastewater discharged to the wastewater treatment plant must undergo integrated wastewater treatment within the plant area before entering the facility. Wastewater discharged from the wastewater treatment plant must also comply with relevant regulations, and the discharge standard refers to the Class II standard of the "Integrated Wastewater Discharge Standard". Wastewater pollution sources and treatment measures are shown in Table 1 below.

2.3 Noise Pollution Sources and Control Measures

The main noise pollution sources of the proposed project are mechanical or aerodynamic noise generated by high-noise equipment such as vacuum pumps, air compressors, cooling towers, and coating machines. The noise source intensity and control measures of the project are shown in Table 2, which is comparable to similar equipment.

As can be seen from Table 2, sound insulation and noise reduction measures have been taken for all major noise sources in the project. After distance attenuation and building sound insulation, the noise at each factory boundary can meet the requirements of the "Environmental Noise Standard for Industrial Enterprises Boundary" (GB12348-2008).

2.4 Solid Waste Generation and Treatment/Disposal Measures

The solid waste generated by this project includes industrial solid waste and domestic waste. Industrial solid waste mainly consists of waste positive and negative electrode plates, wiping cloths (for positive electrode transfer cylinders), aluminum-plastic film, diaphragm scraps, NMP waste liquid, and waste activated carbon. The generation and disposal of various solid wastes are shown in Table 3.

3. Environmental Impact Prediction and Analysis

3.1 Prediction and Assessment of Ambient Air Impact

Predicting pollutants such as dust in engineering projects requires the use of atmospheric estimation models, as shown in the table below, which shows the maximum concentration contribution of fugitive emissions of dust and non-methane total hydrocarbons to the fugitive emission monitoring points at each plant boundary.

Table 1. Source Intensity and Treatment Measures for Wastewater Pollution

pollution source	Wastewater volume (m^3 / d)	pollutants	Production concentration (mg/L)	Handling measures	Emission concentration (mg/L)	destination
from negative electrode slurry transfer tank and agitator cleaning	3.3	COD	500	Sedimentation tank + integrated wastewater treatment facility	COD 62 Ammonia nitrogen 12.8 SS 50	Main discharge outlet
		SS	800			
Domestic sewage	132.8	COD	600	Grease trap/septic tank + integrated sewage treatment facility		
		ammonia nitrogen	40			
		SS	200			
NMP exhaust gas heat exchanger and circulating cooling water system	0.9	COD	50	Integrated wastewater treatment facilities	62	Main discharge outlet
		SS	50		50	
Pure water preparation	0.5	COD	100		62	Main discharge outlet
		SS	150		50	

Table 2. Overview of Noise Sources and Control Measures in Engineering Projects (Unit: dB(A))

Serial Number	Equipment Name	Quantity (units)	Noise source strength	Operating status	Prevention and control measures	Noise reduction effect
1	vacuum pump	6	75-80	continu-ous	Vibration-damping foundation sound insulation of factory buildings	Factory boundary standards met
2	air com-pressor	2	75-80	continu-ous	Vibration-damping foundation sound insulation of factory buildings	Factory boundary standards met
3	Cooling tower	2	75-80	continu-ous	Distance decay	Factory boundary standards met
4	Coating machine	8	71-75	continu-ous	Factory sound insulation	Factory boundary standards met

Table 3. Generation and Disposal of Various Solid Wastes Upon Project Full Production (Unit: t/ a)

Serial Number	Pollution generation process	Solid waste name	Produc-tion	Categories and Codes	Handling and disposal measures
1	Film preparation and slicing	Waste positive and negative plates	4.6	HW49 Other Waste	Entrust a qualified or-ganization to handle it.
2	Positive electrode transfer cylinder	Waste wiping cloths	4	HW49 Other Waste	
3	NMP exhaust gas treatment	Waste activated carbon	18.2	HW49 Other Waste	
4	NMP exhaust gas treatment	NMP waste liquid	99.75	HW42 Waste Organic Solvents	Original manufacturer recycling
5	Cutting edge	Aluminum-plastic film and diaphragm scraps	2	General industrial solid waste	External sales and com-prehensive utilization
6	Various living facili-ties	Household waste	150	General solid waste	Sanitation department cleaning

Table 4. The contribution of fugitive emissions to the maximum concentration at the plant boundary (unit: mg/ m³)

Factory boundary	Dongchang Boundary	South Factory Boundary	West Factory Boundary	North Fac-tory Bound-	Monitoring con-centration limits
Distance of unorganized emission sources from the plant boundary (m)	70	114	228	272	/
Maximum dust concentration contribution value	0.0598	0.0632	0.06074	0.05754	1.0
Maximum Concentration Contribution of Non-Methane Total Hydrocarbons	0.02644	0.0281	0.02658	0.02622	4.0

Table above, 0.0632 mg / m³ is the maximum contribution of fugitive dust emissions to the monitoring point at the plant boundary during the project implementation. Meanwhile, 0.0281 mg / m³ is the maximum contribution of fugitive non-methane hydrocarbon emissions to the fugitive emission monitoring point at the plant boundary. These data demonstrate that the treated exhaust gas emissions meet the fugitive emission monitoring concentration requirements of the “Integrated Emission Standard for Air Pollutants” (GB16297-1996), and the impact of fugitive dust and non-methane hydrocarbon emissions on the surrounding environment becomes negligible.

3.2 Surface Water Environmental Impact Prediction and Assessment

The project adheres to the principles of “separation of clean water and wastewater” and “differentiated treatment based on water quality” in its wastewater treatment, and all wastewater treatment is carried out under these two principles.

Before discharging wastewater into the wastewater treatment plant, the integrated wastewater treatment facility of the unit needs to consider whether the main wastewater is domestic sewage. If so, it needs to refer to the relevant standards, which are specified in the Class I standards of Table 4 of the “Integrated Wastewater Discharge Standard” (GB8978-1996).

A/O (Area-to-Operate) is an improved process that may be used in the treatment of secondary wastewater, and it is quite common in wastewater treatment plants. When wastewater treatment plants treat wastewater according to

relevant standards, if the water quality meets the control standards and the A standard, it can be discharged into the Baihe River.

Before entering the wastewater treatment plant, the wastewater from these projects will be discharged in accordance with relevant emission standards, and the flow direction after entering the plant will also strictly comply with the relevant emission standards. See Table 4 of the "Integrated Wastewater Discharge Standard" (GB8978-1996) for the relevant standards.

Analysis shows that, after treatment by the integrated wastewater treatment facility within the plant, the COD emission concentration at the total discharge outlet meets the Class I standard of Table 4 in the "Integrated Wastewater Discharge Standard" (GB8978-1996). The project's wastewater discharge is small, and this approach will not affect surface water because the wastewater will not be discharged to the surface. Therefore, the impact on surface water becomes negligible.

3.3 Prediction and Assessment of Noise Environmental Impact

These devices have stronger noise sources, ranging from 71 to 80 dB (A). Through various measures of noise reduction equipment, the noise in workshops and other departments can be significantly reduced and maintained below 60 dB (A).

The project reaches full production capacity, the noise contribution values of the noise sources to the east, west, and south plant boundaries during both day and night will meet the Class 3 standard requirements of the "Emission Standard for Environmental Noise at the Boundary of Industrial Enterprises" (GB12348-2008). Therefore, the proposed project will have a relatively small impact on the surrounding acoustic environment after completion.

3.4 Solid Waste Impact Analysis

The project will properly dispose of and recycle the solid waste generated, minimizing the probability of secondary pollution.

4. Clean Production Level Analysis

Construction projects must meet relevant national policy requirements. This necessitates not only advanced production processes but also reduced resource consumption, the adoption of energy-saving and water-saving facilities and technologies, and strict quality control in production processes—controlling pollution sources at their origin and preventing further expansion. Furthermore, effective prevention and control measures are urgently needed for all types of pollutants already emitted to minimize emissions. These two steps can be termed process control and implementation measures, enabling the recycling and reuse of industrial solid waste. Of course, daily operational management also needs to be strengthened, implementing clean production plans and maintaining normal production and business activities to meet the new concepts of clean production and ensure production activities are carried out effectively.

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