Driving the innovation

SUNRESIN

VOCs Treatment with Resin Adsorption

DRIVING THE INNOVATION FOR BETTER PURIFICATION

SEPLITE SEPSOLUT SEPLIFE

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1. About Sunresin
2. Resin Adsorption for VOCs Treatment
3. Applications

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About Sunresin

About Sunresin

- Only listed Chinese company in Adsorption and Separation Technology (SZ 300487)
- Incorporated in Xi'an in 2001.
- Materials (IER, chelating, adsorbents) – Equipment – Solutions
- Recent capacity increase to 50,000 m^3 annually, covering 25 categories and 200 resin types
- Wide applications in Water and Waste water treatment, Environment protection, Food Processing, Biotech, Pharmaceuticals, Plant Extraction, Membrane Caustic Soda, Hydrometallurgy, as well as Municipal Water Treatment etc.

Downstream applications using Adsorption technologies

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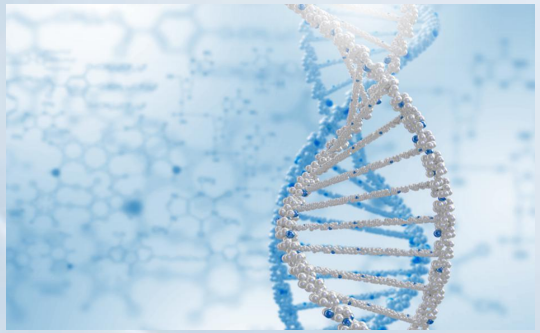

Biomedicine

Hydrometallurgy

Food processing

Water treatment

Power plant

Environment protection

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Development

2001
Founding

2002
Industrialization of juice processing

2004
Special resin manufacturing site

2005
Cephalosporins resin industrialization

2008
Revenue > 100 mil RMB

2010
R&D Center

2012
First EPC in Gallium extraction

2015
IPO
Equipment site

2016
Sunresin campus;
Joint R&D Center with Nankai University

2017
Three New manufacturing sites

2018
Lithium extraction

2019
Acquisition of Belgian Puritech

Accelerated development

Our sites

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Administration & R&D

Sunresin Park, Headquarter

Sunresin, R&D center

SR-Nankai University Joint R&D center

Manufacturing

Sunresin, Gaoling

Sunresin, System Engineering Park

Sunresin, Special Resin Factory

Sunresin, Pucheng

Sunresin, Suncycle Hebi

Sunresin, Puritech Belgium

Business scope

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Equipment and solutions

Simulated Moving Bed
EPC

Bio-pharmaceutical

API, intermediary
Herbal extract
Peptide solid phase synthesis
Chromatography （protein, vaccine, etc)

Environment protection

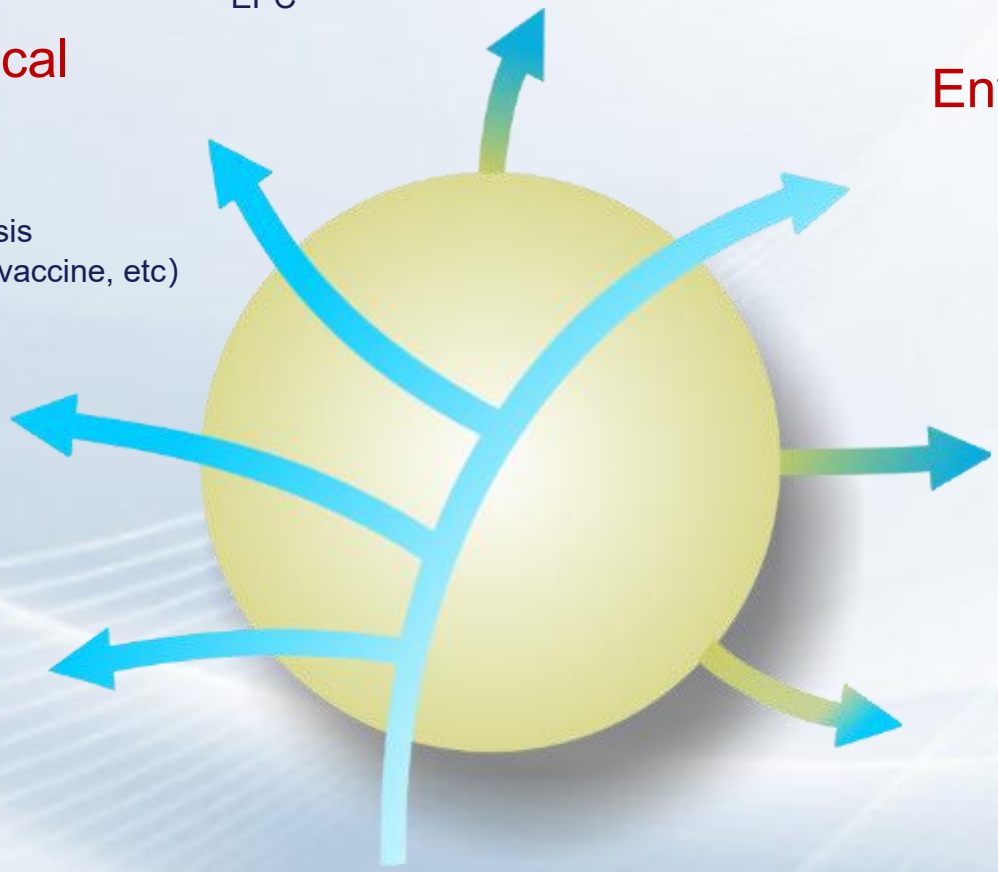
Organic wastewater treatment
Heavy metal treatment and recovery
VOCs treatment

Food processing

Juice
Potable water
Sweetener

Chemicals

Ion-exchange membrane caustic soda
Hydrogen peroxide caprolactam
Petrochemical catalyst



Water treatment

Metal extraction

Gallium, Indium (semi-conductor)
Lithium, lead, cobalt (new energy)

Business Scope

Manufacturing locations in China and Belgium

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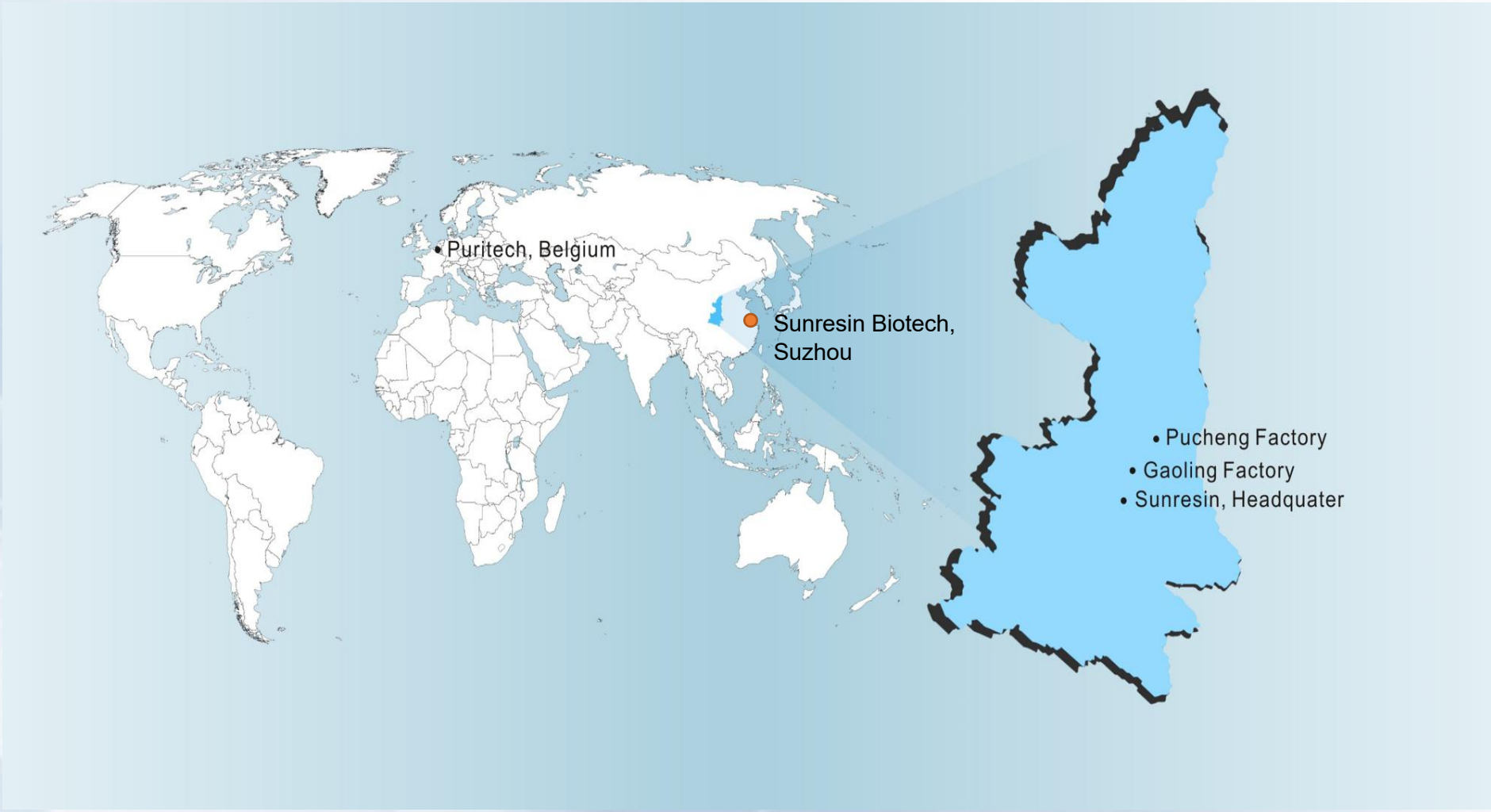
Pucheng factory

Gaoling factory

G1 factory

Puritech



Management

Dr. Ivy Gao Yuejing, President

- Ph. D in Chemical engineering (polymer materials)
- Overseas research at National University of Singapore
- 30+ years industry experience
- State Council Special Government Allowance Expert
- Second prize winner of National Science and Technology Progress Award

Kou Xiaokang, CEO

- 30+ years industry experience
- Editor of leading industry journals
- State Council Special Government Allowance Expert
- Two-time second prize winner of National Science and Technology Progress Award
- Best CEO of Forbes China Listed Companies, 2018
- Taurus Leader of Listed Companies, 2020

Jean-Marc Vesselle, VP

- Former Senior VP of Lanxess
- Nearly 20 years of industry experience
- One of the most influential figures in the resin field

Dr. Joe Lin

- Former Technical Director at Purolite
- Well-known top experts in the industry
- First batch of state-recognized foreign experts with outstanding contributions

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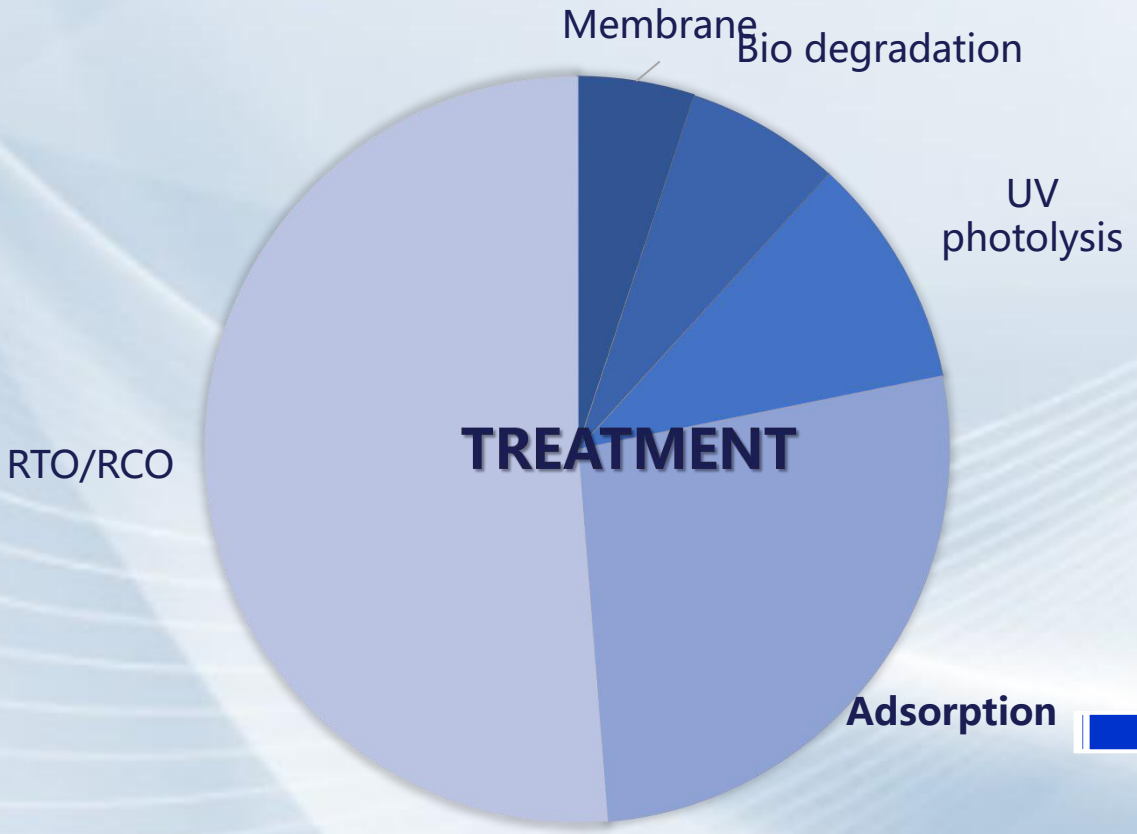
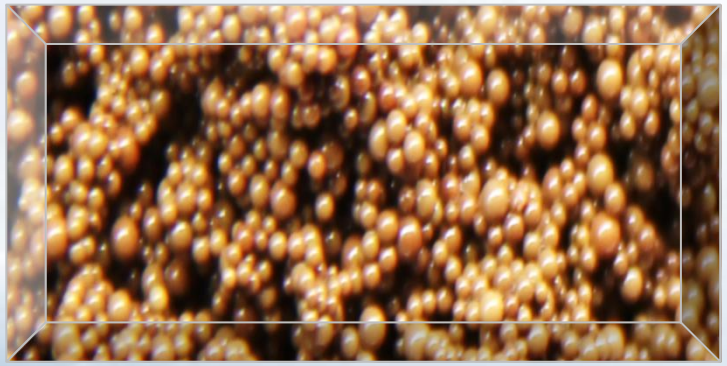
Resin Adsorption for VOCs Treatment

1. Background



- ✓ Multiple process combinations;
- ✓ Co-existence of high and low concentration;
- ✓ Common physical adsorption methods for chlorine, sulfur, nitrogen, and silicon.



What are adsorption resins

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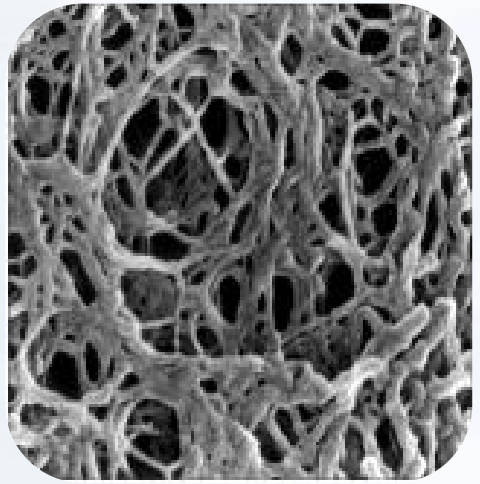

From macro to micro

Resin: High molecular polymer spherical particles with three-dimensional mesh structure and selective adsorption characteristics.

2. Adsorption basics

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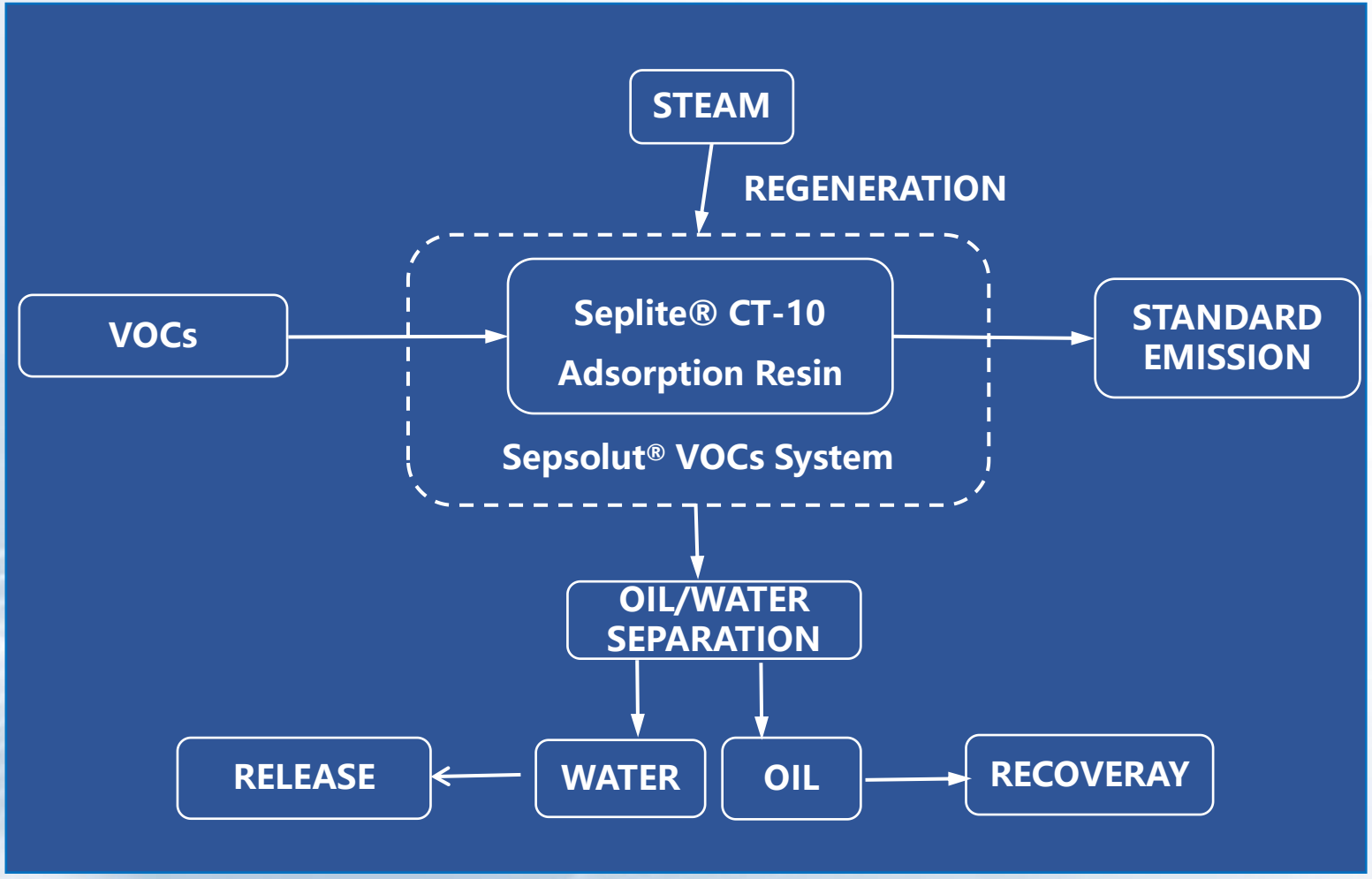
- **Adsorb** and **Recover** the **organic substances** in the waste gas, so as to achieve the purpose of purifying the waste gas.
- Core of the adsorption method: **choice of the adsorption material**.
- With **high adsorption accuracy**, **long life cycle** and **good safety performance**.



3. Advantages of resin adsorption

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Advantages of resin adsorption in VOC capture compared to traditional adsorption techniques

Flexibility: Adaptation to different industries and different systems from small equipment, skid-mounted equipment, to waste gas treatment system. Flexible cooperation to meet emission requirements.

Strength: Regular spherical particles with acid, alkali and high-temperature resistance, over 2000 regeneration cycles.

Purity: Synthetic styrene structure that has no metal impurities, preventing catalytic polymerization or combustion of unsaturated organics in pores.

Efficacy: Over 99.5% removal rate for non-polar and weakly polar VOCs, for emission compliance.

Security: Good hydrophobicity. Thanks to its own water content, no need for dry adsorption, avoiding sustained heating due to adsorption exotherm.

Adsorption Resin vs Activated Carbon

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Item	Adsorption resin	Activated carbon
Shape	Regular spherical particles, more uniform force	Columnar or irregular shape
Purity	Synthetic; Extremely low metal impurities; polymerization or combustion during adsorption process	Naturally formed; Difficult to avoid small amount of metal impurities;
Security	**No hidden dangers such as catalytic**, Adsorption of reactive solvents without catalyzing decomposition	Metal impurities may lead to polymerization and cause intense heat generation; solvent degradation may occur leading to exotherm and subsequent bed fire in extreme cases
	Hydrophobic, no requirement for drying during operation, heat reduction	Need to operate without water, humidity affects the adsorption of VOCs by activated carbon
Strength	Good mechanical strength, acid resistance, alkali resistance, and high temperature resistance	May have impurity release
Life cycle	**Around 5 years (no need for overall replacement, annual replenish <= 10%**)	7-8 months，replaced waste being hazardous
Efficacy	Pore structure can be adjusted during synthesis process, removal rate >= 99% or more	Removal rate >= 92%
Consumption	Clear and transparent desorption solution	Often with black toner impurities
	Low regeneration consumption, around 150-200kg steam for 1m3 of resins. Steam/VOCs ratio about 2:1	Steam/VOC ratio around 5:1

4. Applicable industries

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1. Synthetic drugs, pharmaceutical intermediates

Recovery and treatment of halogenated hydrocarbons, acetic acid, alcohols and esters.

2. Biological fermentation

Ammonia, amine, thioether, thiol, fatty acid, ethyl acetate, butyl acetate, n-butanol

3. Dyestuffs, dye intermediates

Aromatics, chlorinated aromatics, phenols, anthraquinones are recycled

4. Extraction industry

Recovery treatment of n-hexane, cyclohexane, methylcyclohexane, etc.

4. Applicable industries

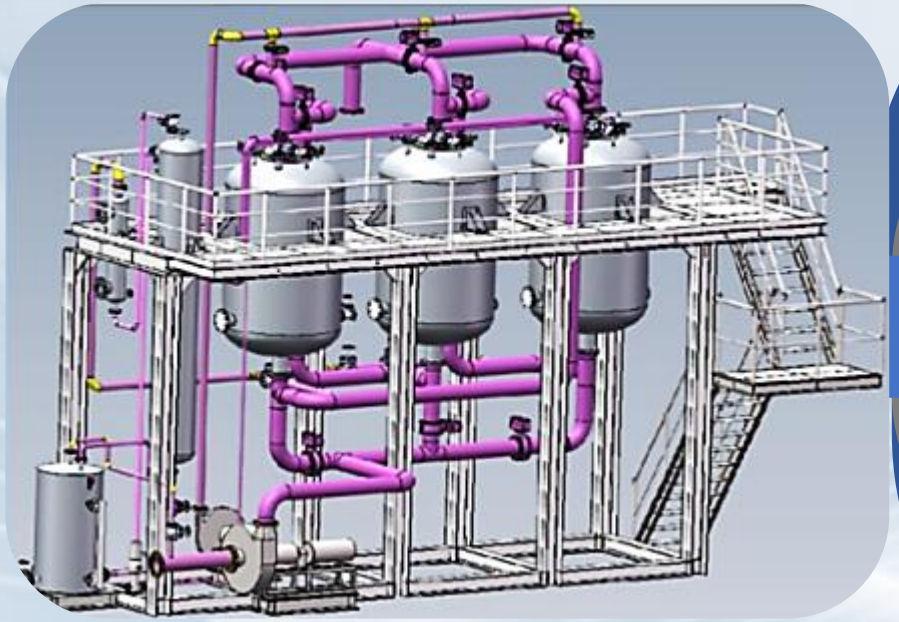
5. **Pesticides, Active Pharmaceutical Ingredients**
   Recovery and treatment of pyrethrins, pyridine, imidazole, acid chloride, biphenyl and heterocycles.

6. **Hydrogen peroxide**
   Treatment of heavy aromatics in oxidized exhaust gas.

7. **Petrochemicals, surfactants and leather**
   Adsorption and recovery of exhaust gas and high-carbon alcohol from the breathing valve in the tank area.

8. **Chloride**
   Treatment of vinylidene chloride, chlorobenzene, chloroethylene oxide, etc.

5. Design principles



1. More convenience: Skiddable overall design
2. More security: Pressure and temperature interlocking
3. More efficiency: Waste gas from breathing port returning to adsorption
4. Water tank for cooling and fire risk
5. Internal structure reducing wind resistance and consumption

6. VOCs adsorption materials - Seplite CT10 resin

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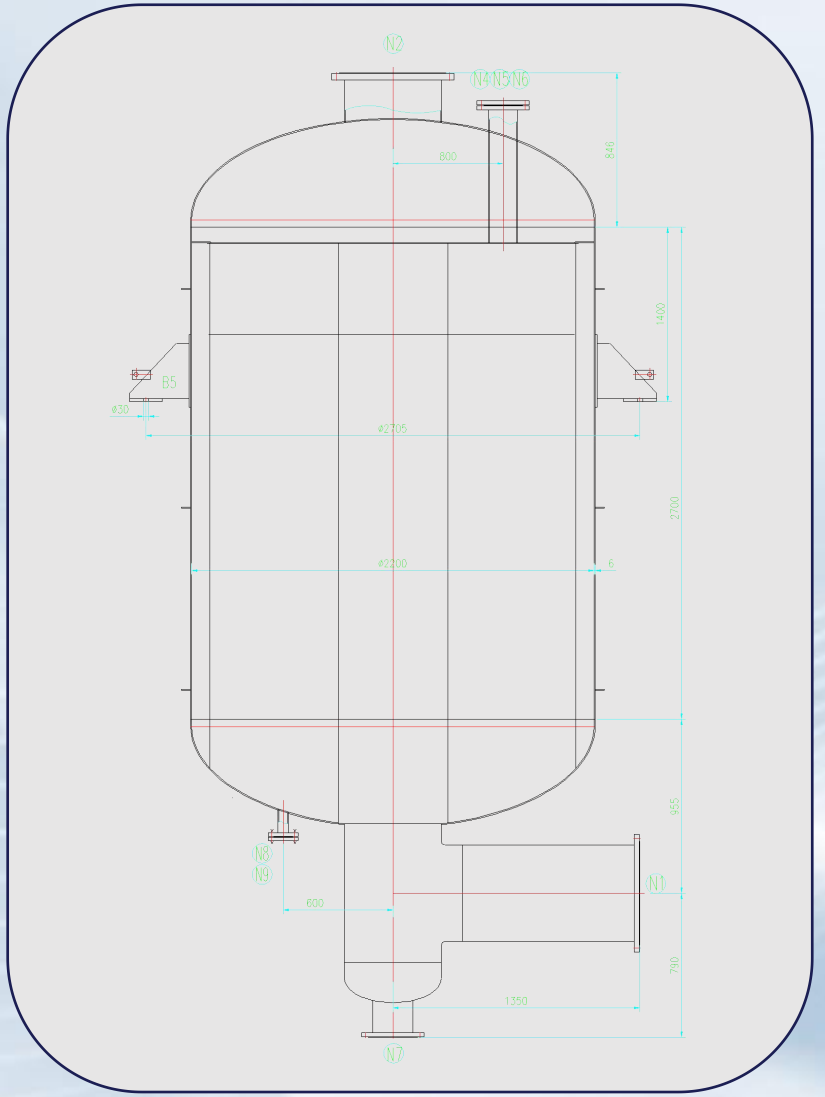
SEPLITE® CT10

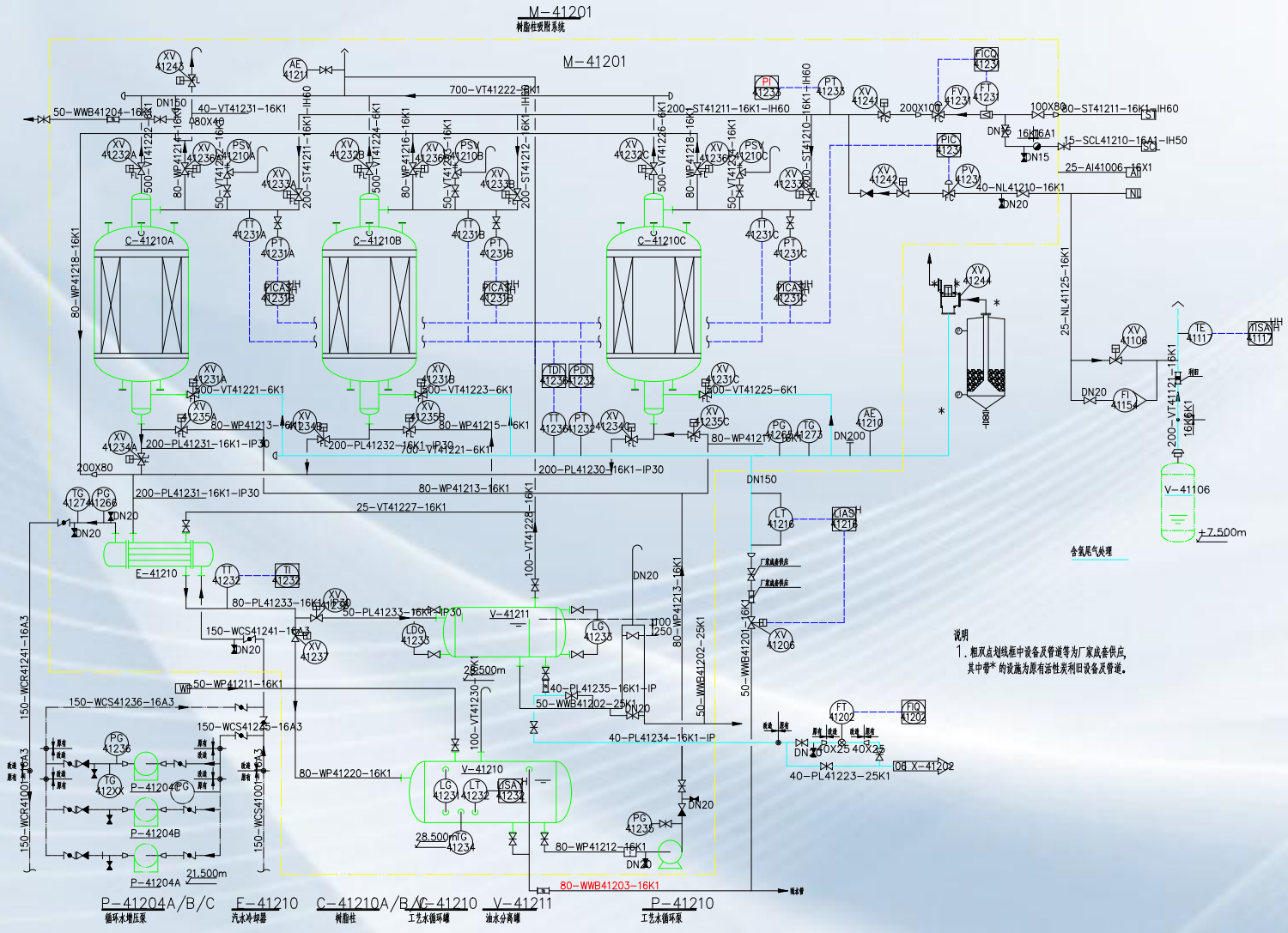
- Styrene-DVB macroporous resins for VOCs adsorption
- Special structure design, high specific surface area
- Ability to selectively adsorb organic molecules and can be adapted to high, medium and low concentrations of VOCs to achieve emission compliance
- High strength and degree of polymerization allowing thousands of adsorption and desorption cycles.
- High resistance to temperatures, acids, alkalis, and solvents.

7. Structure of Resin Adsorption Tower



- Stainless steel material, high temperature resistance, solvent resistance
- Annular resin filling providing a larger resin contact area
- High utilization rate of effective volume and smaller floor space
- Special internal structure to prevent waste gas drifting

8. Operation process

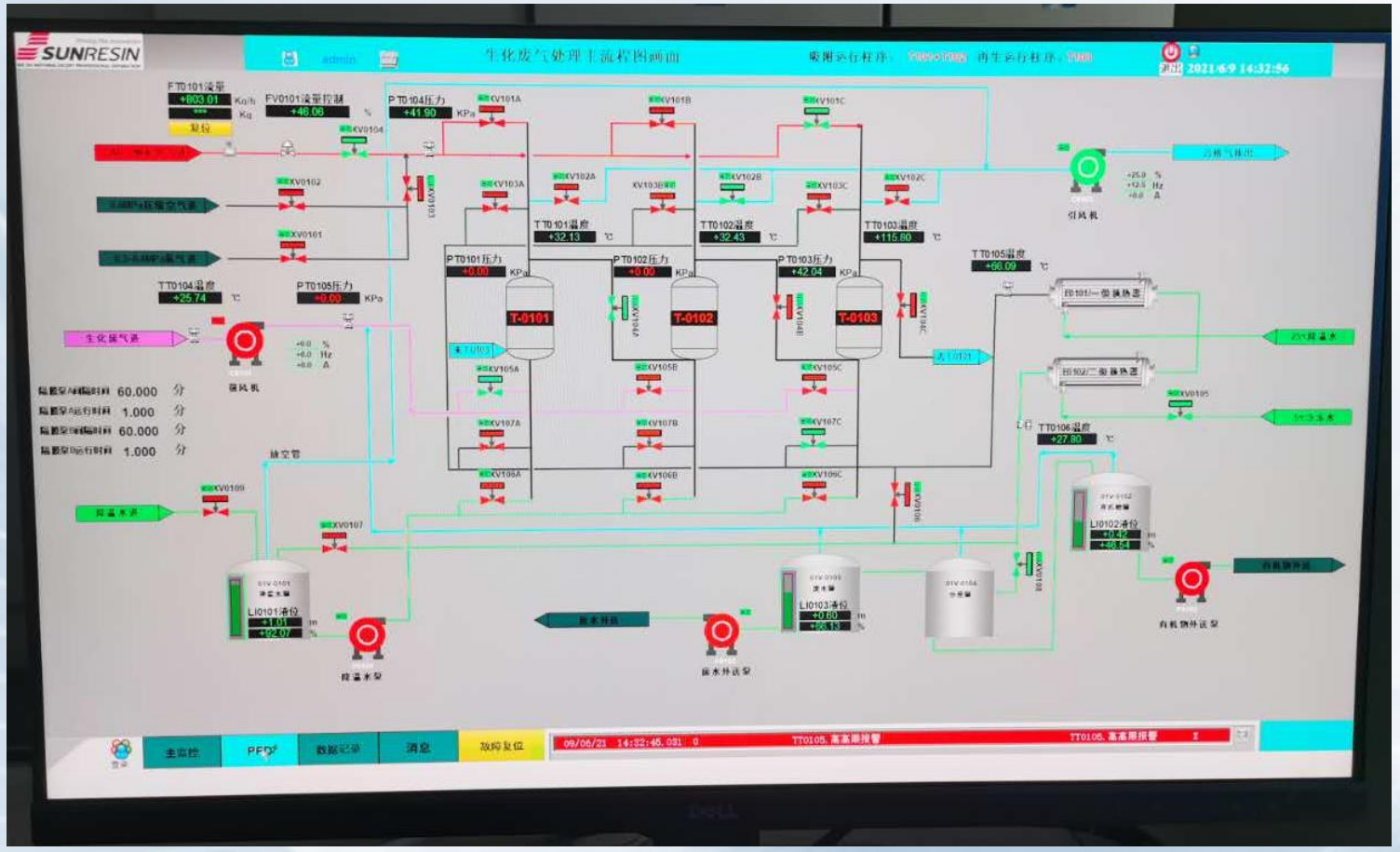


- Three columns, two parallel, one standby operation mode to ensure the waste gas adsorption rate
- More flexible operation mode
- Fully automatic, unattended

Control Panel

- Open parameters of each process section
- Multiple ways to control progress
- Different regeneration times can be set for peak and low emissions

Control Panel - 2



- User-friendly
- chain analysis
- Complete alarm measures

9. Consumptions and OPEX (ex.)

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18,100m3/h Oxidation Waste Gas Project				
Name	Average consumption	Peak consumption	Annual consumption (360 days)	OPEX annually
Recycled water (32℃)	87.5 m^3/h	350 m^3/h	756,000 m^3	<1 million RMB (153,500 USD)
Electricity	15 kw/h	15 kw/h	129,600 kw	
Instrument air	0.053 Nm^3/h	189 Nm^3/h	457.92 Nm^3	
Tap water	0.0037 m^3/h	20 m^3/h	31.968 m^3	
Steam (0.5Mpa)	418 kg/h	1,714 kg/h	3,341 t	
Waste water	0.418 t/h	1,714 t/h	3,341 t	
Nitrogen	15 Nm^3/h	360 Nm^3/h	129,600 Nm^3/h	

10. Profit and Loss (ex.)

Project	Maximum profit per day (according to the maximum design value)	Maximum annual profit	Return value
Heavy aromatics	1,300 kg	432 t	3.45 million RMB (520k USD)

Applications and Case Studies

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Applications

- Synthetic drugs, pharmaceutical intermediates
- Dyestuffs, dye intermediates
- Pesticides, raw materials
- Petrochemicals, surfactants and leather
- Biological fermentation
- Extraction industry
- Hydrogen peroxide
- Chlorine chemical industry

Case studies

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Industry	Location	Air volume (m³/h)	VOCs
Pharma	Zhejiang	8,000	Toluene, chlorobenzene, ethyl acetate
Hydrogen peroxide	Zhejiang	16,000	Trimethylbenzene (AR)
Petrochemical	Hubei	1,000	Toluene, xylene
Dye ware	Jiangsu	2,000	Dichloroethane
		2,000	Chlorobenzene
Pharma ①	**Jiangsu**	**1,500**	**Dichloromethane**
Chemical	Jiangsu	3,000	Chloroform
		3,000	Dichloromethane
		3,000	Dichloroethane
Chemical	Jiangsu	500	Methacrylic Chloride
Chemical	Henan	5,000	Dichloroethane
Chemical and Pharma	Jiangsu	5,000	Chlorobenzene
Chemical	Jiangsu	3,000	Dichloromethane
		3,000	Chlorobenzene
Petrochemical	Zhejiang	12,000	Heavy aromatics
Chemical ②	**Hebei**	**12,000**	**Waste gas containing naphthalene**
Sugar	Shandong	2,000	Ethylene oxide
Pharma	Zhejiang	3,000	Dichloromethane
Fine Chemicals and pesticide	Jiangsu	3,000	Dichloroethane
Pharma	Shandong	10,000	Dichloromethane
H2O2 ③	**Hunan**	**18,000**	**Heavy aromatics (xylene, benzene, toluene, etc)**
Lithium battery separator industry ④	**Guandong**	**5,000**	**Dichloromethane**

Case study ① - Phmarceutical plant in Jiangsu - Dichloromethane

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- Air volume: 1,500 m^3/h
- Concentration: 50,000-60,000 mg/m^3
- Outlet concentration: ≤200 mg/m^3
- Operation mode: Three columns, two series, one standby
- Resin column loading method: tile
- Regeneration time: 3h
- Outlet destination: RTO

The following characteristics were found during the operation of the device：

1. After the first-stage adsorption, the temperature of the waste gas rose about 10-15°C
2. When the inlet temperature was at 50°C (boiling point of dichloromethane being 40°C), the adsorption capacity was not affected, but the outlet concentration was affected.

Case study ② - Naphthalene-containing waste gas from a dyestuff enterprise in Tangshan

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- Air volume: 12,000 m^3/h
- Plant conditions: deodorization needed (naphthalene)
- Outlet conditions: no odor
- Operation mode: Three columns, two parallel, one standby
- Resin per column: 4 m3

Features of the device：

1. For low-content waste gas, the concentration and resin consumption are balanced, and the parallel intake air is adopted to operate at a staggered time.
2. All equipment were made of carbon steel, saving cost
3. According to the characteristics of easy sublimation of naphthalene, the heat exchanger was omitted, and the steam regeneration was directly passed to the waste water tank.

Case study ③ - recovery of heavy aromatics from oxidation tail gas in Hunan - H2O2 industry

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- Air volume: 18,000 m^3/h
- Inlet conditions: Heavy aromatics content around 9,000 mg/m^3
- Outlet conditions: Xylene <20 mg/m3, benzene <4 mg/m3, toluene <15 mg/m3, non-methane total hydrocarbons <60 mg/m3
- Operation mode: Three columns, two parallel, one standby
- Resin per column: 9 m3

Features of the device：

The annular packing bed was adopted

Gas feed came through the middle of the resin column and passed the bed laterally

Increased contact area, reduced thickness of the resin bed, reduced wind resistance.

Case study ④ - Dichloromethane recovery in lithium battery separator industry in Guangdong

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- Air volume: 5,000 m^3/h
- Inlet concentration: 175,000mg/m^3 (dichloromethane, loss amount is 21t/d)
- Outlet conditions: Waste gas dichloromethane <20mg/m^3, waste water dichloromethane <1mg/L
- Operation mode: Continuous adsorption and desorption system + two series one standby + wastewater adsorption
- Resin per column: 8 m3

Features of the device：

1. Continuous adsorption and desorption (5-column) design significantly saving the amount of resin and thus energy consumption
2. Recovery system and standard emmission system working together to meet emission criteria (<20mg/m^3)
3. Wastewater generated by steam regeneration treated by linkage adsorption to ensure that the dichloromethane in the drainage is ≤1mg/L

Case study ④ - Dichloromethane recovery in lithium battery separator industry in Guangdong

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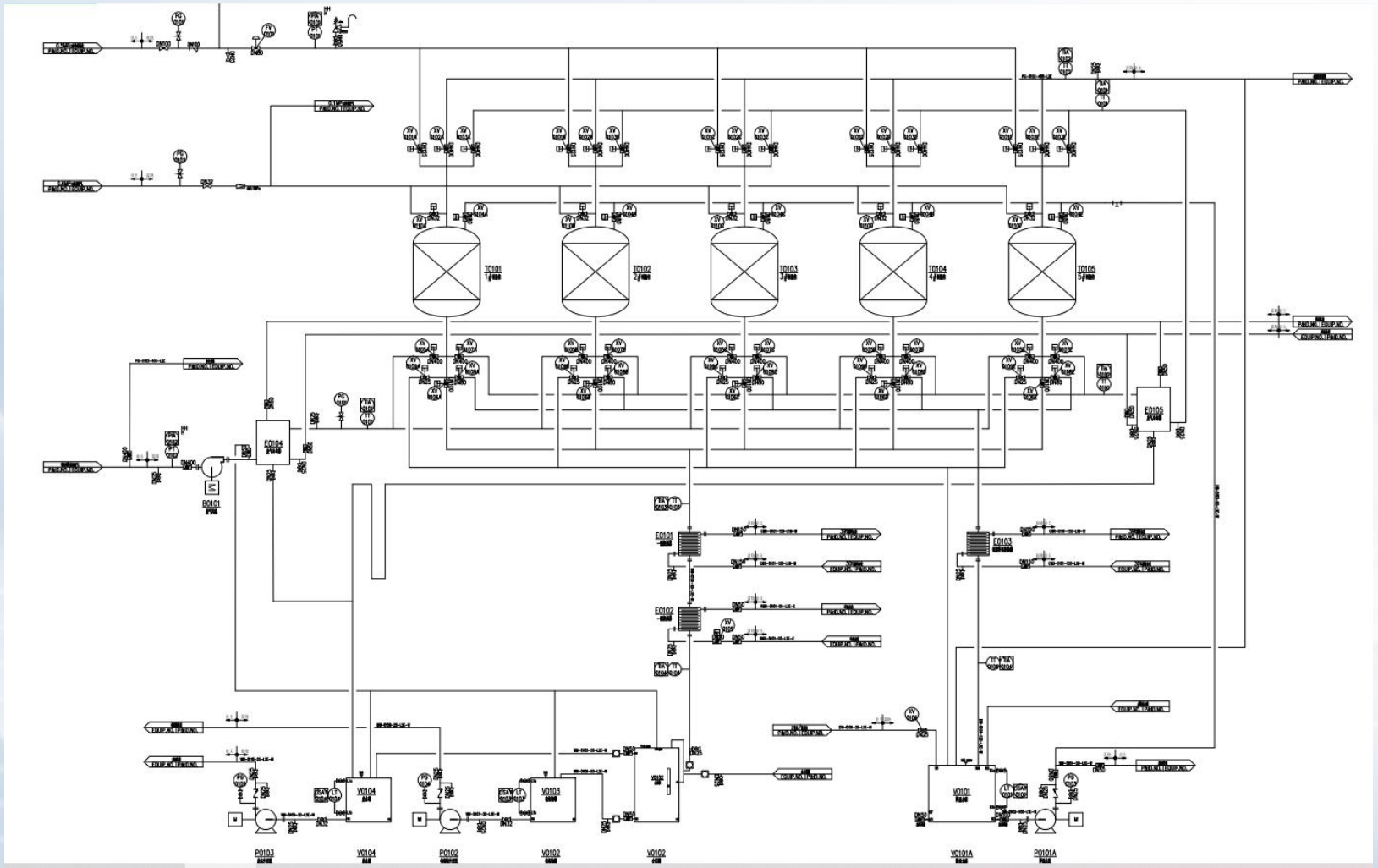

Continuous adsorption and desorption system

Case study ④ - Dichloromethane recovery in lithium battery separator industry in Guangdong

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Switch	Adsorption	Regeneration	Cooling	Drainage	Note
1	A+B	E	D	C	Switch time: 36min Removal rate of dichloromethane ≥90%
2	B+C	A	E	D	
3	C+D	B	A	E	
4	D+E	C	B	A	
5	E+A	D	C	B	
6	A+B	E	D	C	

Case study ④ - Dichloromethane recovery in lithium battery separator industry in Guangdong

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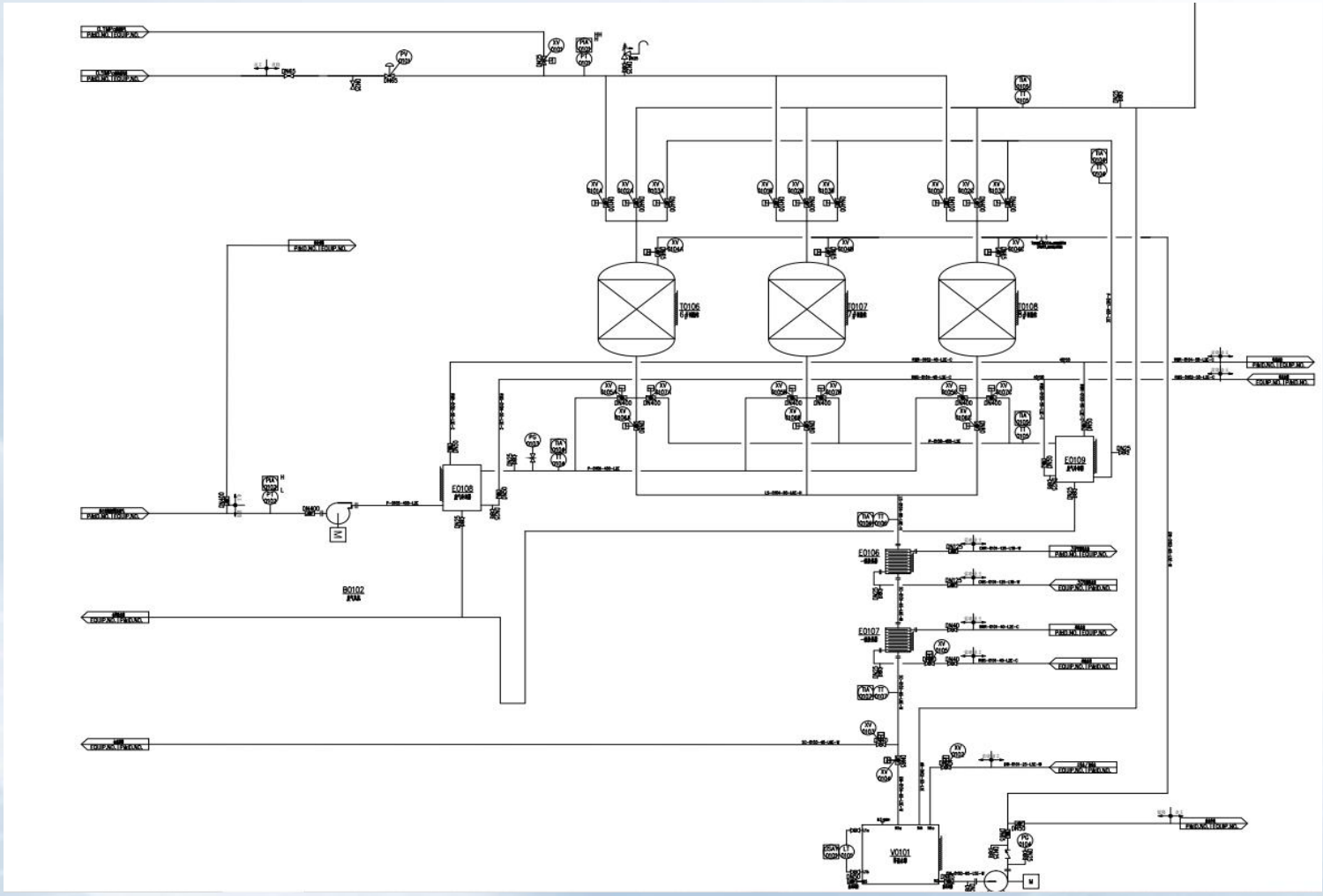

Two series one standby to meet the emission standard

Case study ④ - Dichloromethane recovery in lithium battery separator industry in Guangdong

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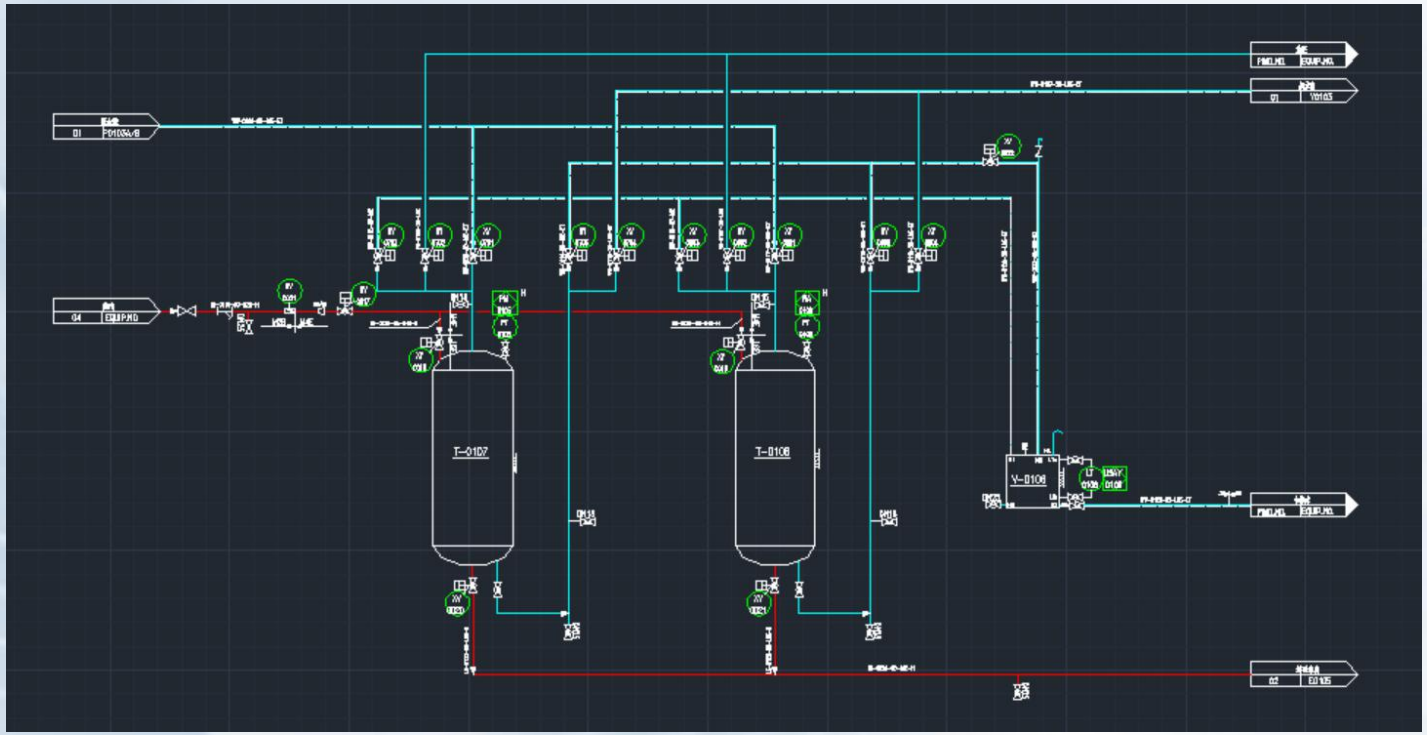

Wastewater treatment

- Water volume 42t, one for use and one for backup
- Single column 2m³ resin, shared regeneration with waste gas system
- Ensure that the dichloromethane content in wastewater is ≤1mg/L

Waste gas monitoring report

CTI 华测检测 CENTRE TESTING INTERNATIONAL

CMA 171012050472

检 测 报 告

报告编号 A2200197423102C 第 1 页共 5 页

委托单位 西安蓝晓科技新材料股份有限公司

受检单位 江苏安邦电化有限公司

受检单位地址 淮安市化工路 30 号

样品类型 废气

报告用途 自检

淮安市华测检测技术有限公司

No.4028211BC2

淮安市华测检测技术有限公司 淮安市清江浦区水渡口大道 121 号

Q/CTILD-HACEDD-0034-F05 版本/版次：1.0

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CTI 华测检测 CENTRE TESTING INTERNATIONAL

检 测 结 果

报告编号 A2200197423102C 第 3 页共 5 页

表 1：

样品信息：

检测类型	采样介质	采样方式	采样人员
废气	吸附管、气袋	连续	赵磊、丁雷

表 2：

样品信息：

样品类型	工业废气		
采样点名称	废气进口		
采样日期	2020-06-29	检测日期	2020-06-29~2020-06-30
采样方式	连续	样品状态	完好
排气筒高度/m	/	排气筒面积 m^2	0.0707

检测结果：

样品编号	检测项目	结果 废气进口	
		实测浓度 mg/m^3	排放速率 kg/h
HAM6242 1002	1,2-二氯乙烷	>299	>0.17
HAM6242 1001	非甲烷总烃	1.82×10^3	1.03
HAM6242 1002	1,1-二氯乙烷	0.28	1.59×10^{-4}

采样参数：

测试项目	参数	单位	结果
1,1-二氯乙烷、非甲烷总烃、1,2-二氯乙烷	含湿量	%	2.60
	大气压	kPa	100.70
	平均流速	m/s	2.6
	平均烟温	℃	29.7
	标干流量	m^3/h	568
	烟气流量	m^3/h	650

注：">"表示检测项目已超过仪器响应范围，出现平头峰，实验室无法准确测出其浓度，结果仅供参考。

淮安市华测检测技术有限公司 淮安市清江浦区水渡口大道 121 号

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检 测 结 果

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表 3：

样品信息：

样品类型	工业废气		
采样点名称	废气出口		
采样日期	2020-06-29	检测日期	2020-06-29~2020-06-30
采样方式	连续	样品状态	完好
排气筒高度/m	30.0	排气筒面积 m^2	0.0707

检测结果：

样品编号	检测项目	结果 废气出口	
		实测浓度 mg/m^3	排放速率 kg/h
HAM6242 1004	1,2-二氯乙烷	2.57	1×10^{-3}
HAM6242 1003	非甲烷总烃	292	0.142
HAM6242 1004	1,1-二氯乙烷	ND	/

采样参数：

测试项目	参数	单位	结果
1,1-二氯乙烷、非甲烷总烃、1,2-二氯乙烷	含湿量	%	2.40
	大气压	kPa	100.70
	平均流速	m/s	2.2
	平均烟温	℃	30.8
	标干流量	m^3/h	487
	烟气流量	m^3/h	558

注：1."ND"表示未检出。
2."/"表示检测项目的排放浓度小于检出限，故排放速率无需计算。
3.排气筒高度由客户提供。

淮安市华测检测技术有限公司 淮安市清江浦区水渡口大道 121 号

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Toluene waste gas treatment project

Chlorine-containing waste gas adsorption and recovery project

Waste gas adsorption recovery project

Waste gas adsorption project

VOC treatment equipment in one minute

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Click here to learn more about Sunresin's VOCs treatment

www.youtube.com/watch?v=FvBKI7ahMJg

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SUNRESIN

Thank you

DRIVING THE INNOVATION FOR BETTER PURIFICATION

SEPLITE SEPSOLUT SEPLIFE