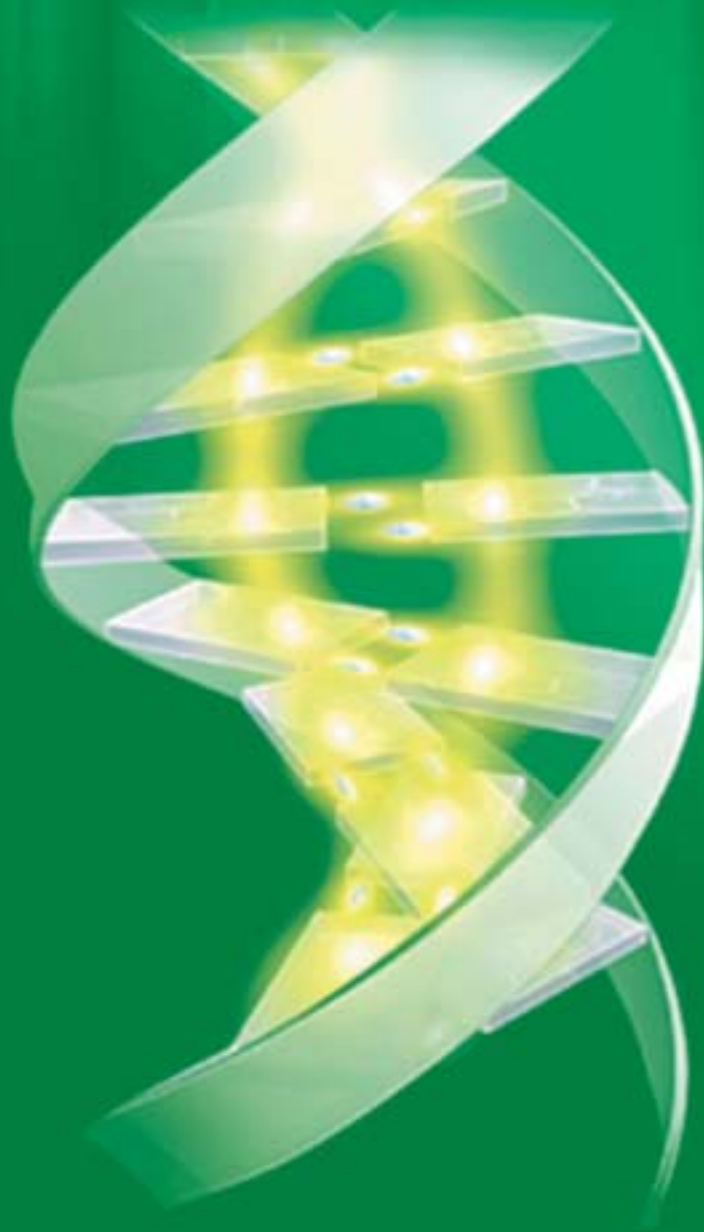


PRODUCT LIST

Environment Protection Catalysts and Systems



NIPPON
SHOKUBAI

Environment Protection Catalysts and Systems

Contents

Catalysts

De-NOx Catalyst	2
Dioxins Decomposition Catalyst	3
Waste Gas Treatment Catalyst	4
Wastewater Treatment Catalyst (Catalytic Wet Oxidation)	5
Ammonia (Waste Water) Treatment Catalyst	7
Other Catalysts	9



De-NOx Catalyst

Nitrogen oxides (NOx) discharged from various stationary combustion systems (such as industrial boilers, private power generation systems and furnaces, power stations) and metal etching are believed to be the major air polluting substance causing air pollution, and regulations for controlling NOx emission have been effectuated in many countries. For NOx reduction, the selective catalytic reduction (SCR), using ammonia as a reducing agent has been widely used. The De-NOx catalyst used for this process is key of SCR.

Nippon Shokubai's De-NOx catalyst is widely used in the De-NOx systems for various exhaust gas sources such as boilers and power stations.

1. Features

- 1) Suitable catalyst selection complying to various exhaust gas sources such as boilers, gas turbines, diesel engines, cement kilns, sintering and heating furnaces, waste incinerators.
- 2) High NOx-reducing rates in a wide temperature range from 160 to 600 .
- 3) Durable catalysts by SOx in the exhaust gas and various poisonous substances in the dust keep a high De-NOx activity for a long period of time.
- 4) Due to low SO2 oxidation rate, less formation of ammonium sulfates.
- 5) By changing the number of cells (sieve opening) of catalyst, it is applicable to any exhaust gas from coal-fired boilers with a high dust abrasion resistivity.
- 6) High heat-resistance and water-resistivity.

2. Catalyst Size

As standard size, the honeycomb shape catalyst having outside dimension of 150 mm x 150mm and length from 400 to 1,060mm is widely used. Typical examples are as below :

Size

	1	2	3	4	5	6	7	8	9	10
Outer size (mm)	150	150	150	150	150	150	150	150	150	150
No. of cell (pcs)	20x20	21x21	25x25	26x26	30x30	35x35	40x40	45x45	50x50	60x60
Pitch (mm)	7.35	7.0	5.95	5.7	4.95	4.25	3.7	3.3	2.96	2.5
Sieve opening (mm)	6.35	6.0	5.05	4.85	4.15	3.65	3.2	2.9	2.56	2.1
Wall thickness (mm)	1.0	1.0	0.9	0.85	0.8	0.6	0.5	0.4	0.4	0.4
Contact area(m ² /m ³)	451	470	561	582	664	794	910	1,044	1,137	1,340
Opening rate (%)	71	70	71	70	69	72	72	76	72	70
Mass-production max. length (mm)	1,060	1,060	1,060	1,060	1,060	1,060	1,060	800	600	600

Size selection by fuel

Coal (High Dust)

Coal (Low Dust)

Heavy oil

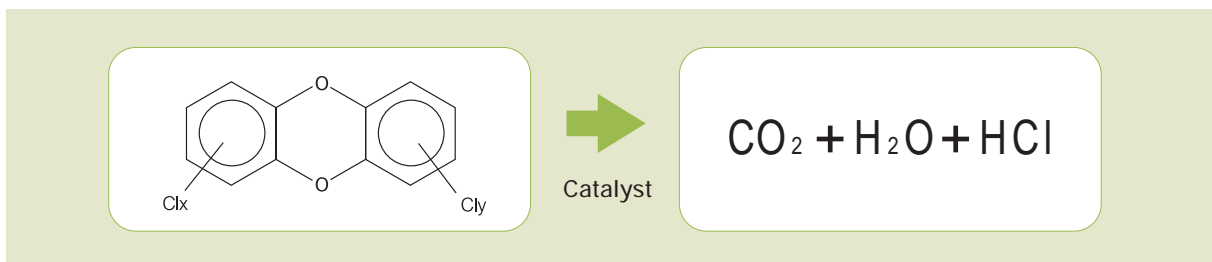
Gas



Dioxins Decomposition Catalyst

Dioxins/Furans (DXNs) caused by incineration of municipal and industrial wastes have become a big social problem. Methods of removal of DXNs in off-gases are adsorption by injecting activated carbon powder, adsorption by activated carbon columns, decomposition by catalyst and etc., among which catalytic method is one of the best as it can directly decompose DXNs to convert into harmless materials.

Reaction of DXNs Decomposition



In the catalytic decomposition of DXNs, DXNs are reacted on the catalyst with oxygen in off-gases and are converted into harmless carbon dioxide and water. In this reaction, hydrogen chloride is also formed at the same time, level of which is as low as it does not affect to the environment as the concentration of DXNs in off-gases is very low. Furthermore, toxic organo-chlorine compounds such as Coplanar PCBs other than DXNs can also be effectively decomposed by the similar reaction.

1. Features

- 1) Higher decomposing efficiency of more than 99%.
- 2) Decomposition at a wide temperature range from 160 to 350 .
- 3) No need for secondary treatment, as DXNs are decomposed into harmless carbon dioxide and water.
- 4) Simultaneous removal of NOx in high efficiency by injecting ammonia.
- 5) Less clogging of catalyst with dust and less pressure drop through catalyst layers.

2. Catalyst Size

The honeycomb shape catalyst having outside dimension of 150mm x 150mm and length of max.1,060mm is used. Typical examples are as below:

	1	2	3	4	5
No. of Cell (pcs)	20 x 20	25 x 25	30 x 30	35 x 35	40 x 40
Pitch (mm)	7.35	5.95	4.95	4.25	3.7
Sieve Opening (mm)	6.35	5.05	4.15	3.65	3.2

Waste Gas Treatment Catalyst



Nippon Shokubai's waste gas treatment catalyst (complete oxidation catalyst; ex. VOCs, odorants) is manufactured under its strict quality controls which are based on the catalyst technology developed and accumulated since its foundation in 1941. Therefore its stable activity can be maintained for a long period of time.

Due to use of noble metals such as Pt/Pd, Nippon Shokubai's waste gas treatment catalysts can provide an excellent purifying performances even in low temperature areas.

Typical examples of Nippon Shokubai's waste gas treatment catalyst are shown in the table below. The most suitable catalyst can be selected complying to various types of waste gases.

1. Features

- 1) Optimum catalyst type selection for various types of waste gas.
- 2) Excellent oxidation activity at low temperatures.
- 3) High efficiency noble metal catalyst with high deodorization effect.
- 4) Less harmful effect by poisonous substances in waste gas, more stable activity with a long period of time.

When the poisonous substances concentration in waste gas is high, use of the pretreatment catalyst is recommended.

- 5) A stable performances by low pressure drop and sufficient contact effect with waste gas.
- 6) Excellent heat-resistance.

2. Catalyst Size

Types and features of waste gas treatment catalyst

Shape	Type	Size	Features
Honeycomb	CH-700 Series	150mm × 50mmL	For standard use
	CH-800 Series		Heat resisting
	CHT Series		SOx resisting
	STH Series	150mm × 70mmL	For nitrogen compounds and/or organic halogen compounds
Spherical	C-700 Series	3 ~ 5mm	For standard use
	C-800 Series		Heat resisting
	C-900 Series		Pretreatment



Wastewater Treatment Catalyst (Catalytic Wet Oxidation)

Nippon Shokubai's wastewater treatment catalysts are widely used in the catalytic wet oxidation wastewater treatment systems. Toxic COD components, organic nitrogen compounds, ammonia, sulfur compounds and organic chlorides are oxidized into carbon dioxide, water, molecular nitrogen, sulfate, and hydrochloride by the liquid phase catalytic oxidation. This wastewater treatment catalyst is suitable for treating $COD_{Cr}=5,000 \sim 150,000\text{mg/L}$ in wastewater. Also, this catalyst is suitable for the pretreatment system of activated-sludge method.

1. Merits

- 1) Simultaneous treatment of COD and removal of nitrogen and sulfur compounds.
- 2) Low running cost.
- 3) A compact plant design for low space requirements.
- 4) Stable continuous and automatic operation.
- 5) Even COD_{Cr} of $20,000\text{mg/L}$ in wastewater can be treated without supplying any auxiliary fuel.
- 6) Recovered energy as steam from the oxidation reaction of the wastewater.
- 7) Deodorization and decolorization.
- 8) Clean, SO_x , NO_x , and Dioxins free off gas.
- 9) No secondary pollutants, like sludge and ashes.
- 10) Treated on the high performance water can be reused.

2. Applicable wastewater

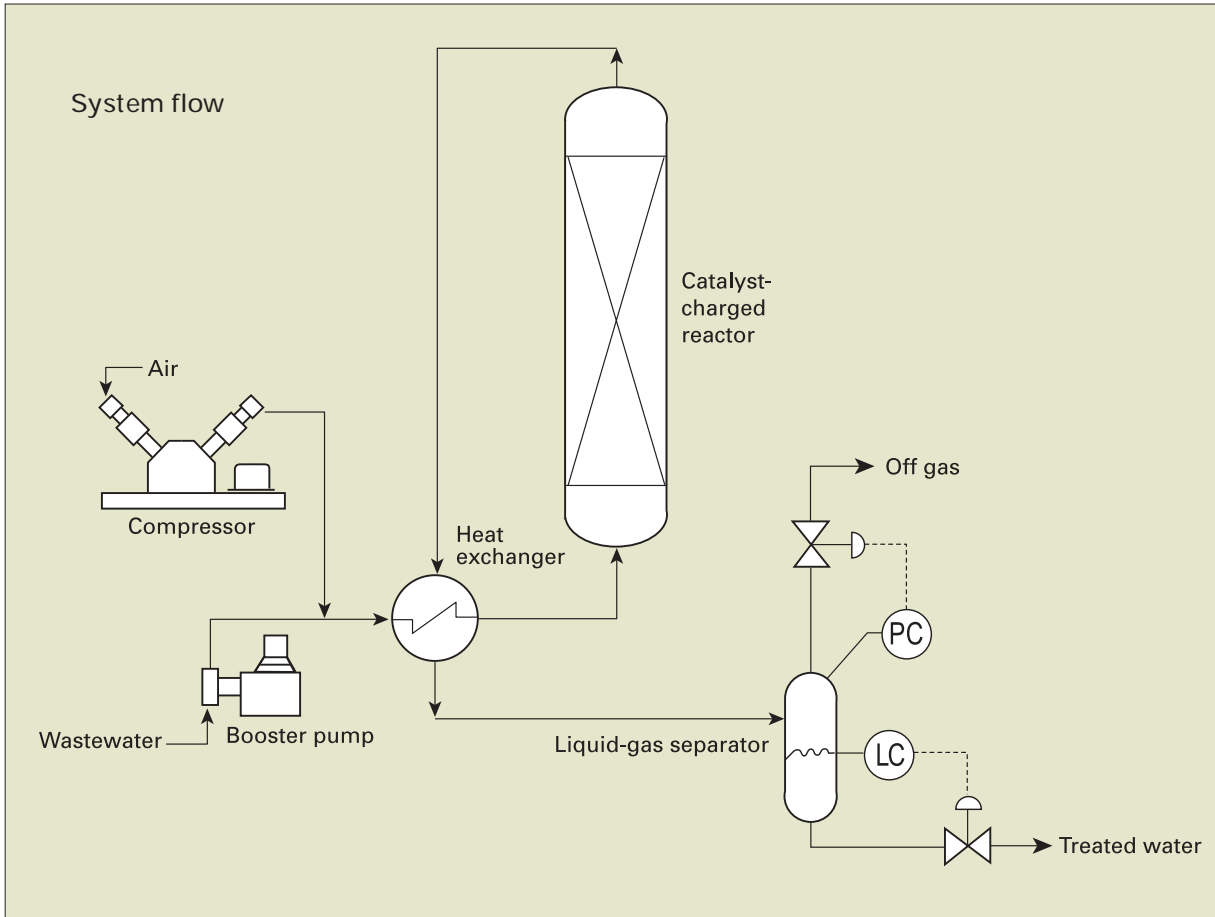
- 1) COD components formalin, acetaldehyde, glyoxal, phenol, dioxane, methyl methacrylate (MMA), formic acid, acetic acid, acetone, tetrahydrofuran (THF), methyl ethyl ketone (MEK), methyl alcohol, terephthalic acid, ethylene glycol, pentaerythritol etc.
- 2) Sulfur compounds sodium sulfide, sodium thiosulfate, dimethyl sulfoxide (DMSO) etc.
ex. wastewater from ethylene plants and spinning plants etc.
- 3) Nitrogen compounds ammonia, isocyanate, acrylonitrile etc.
- 4) Organic chlorides dioxin etc.

3. Catalyst

The catalysts which were developed entirely by Nippon Shokubai are charged into the reactor, and they are cylindrical pellets.

4. System Flow

This system is composed of the process units of wastewater supply, compressed air supply, heat exchanging, catalytic reaction and liquid-gas separation.





Ammonia (Waste Water) Treatment Catalyst

We Developed catalyst as nitrogen compounds decomposition catalyst originally. This catalyst can decompose ammonia to N_2 and H_2O with one step while formation rate of NO_x is low.

For the removal of ammonia from waste water, after the ammonia in waste water is vaporized at radiation tower, ammonia can be decompose by introducing the gas into the reactor which is filled with this catalyst.

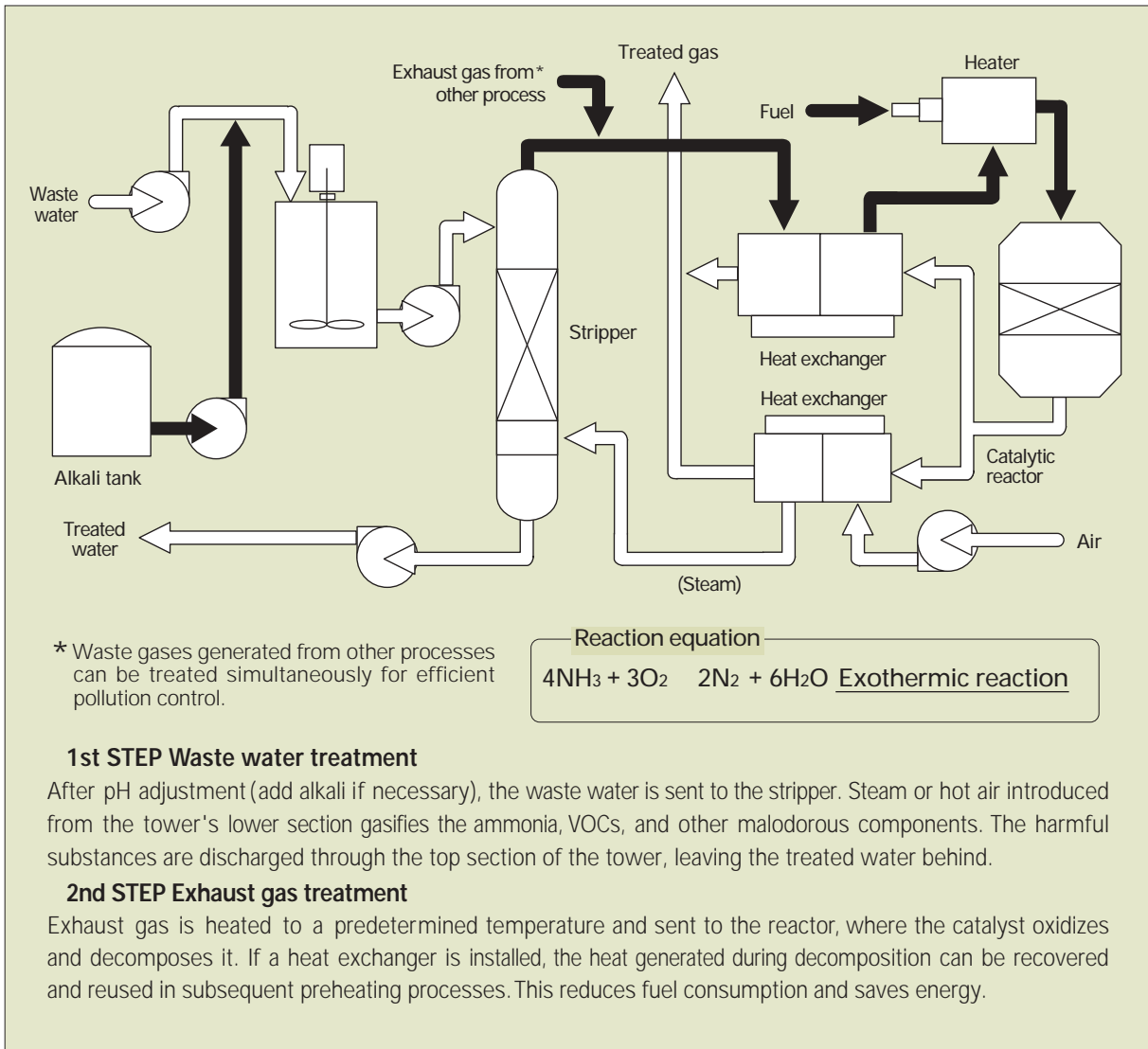
1. Features

- 1) Treats effectively -without generating secondary waste
- 2) Single-stage treatment of ammonia gas from stripper
- 3) Works with a wide range of ammonia concentration
- 4) Saves energy by recovering waste heat
- 5) Comprehensive treatment
- 6) Compact size saves space

2. Applications

Industry	Application
Iron and Steel	Coke, coal tar and steel manufacturing
Inorganic Chemical	Inorganic chemical manufacturing
Electric Power	Demineralization of condensed waste water and desulfurization waste water treatment
Coloring and Dyeing	Dyeing assistant auxiliary, synthetic dye, and organic/inorganic pigment manufacturing
Food	Food processing, fermentation, and gelatin and starch manufacturing
Semiconductor and Electronic Component	Semiconductor and electronic component cleaning, etching, and parts manufacturing
Chemical	Organic synthesis, caprolactam manufacturing, and soda manufacturing
Pharmaceutical	Medicine and agrochemical manufacturing
Fertilizer and Fodder	Fertilizer and fodder manufacturing
Sewage and Manure Treatment	Waste water and sludge treatment, and compost production
Industrial Waste Handling	Waste water and sludge treatment

3. System Flow



1st STEP Waste water treatment

After pH adjustment (add alkali if necessary), the waste water is sent to the stripper. Steam or hot air introduced from the tower's lower section gasifies the ammonia, VOCs, and other malodorous components. The harmful substances are discharged through the top section of the tower, leaving the treated water behind.

2nd STEP Exhaust gas treatment

Exhaust gas is heated to a predetermined temperature and sent to the reactor, where the catalyst oxidizes and decomposes it. If a heat exchanger is installed, the heat generated during decomposition can be recovered and reused in subsequent preheating processes. This reduces fuel consumption and saves energy.



Other Catalysts

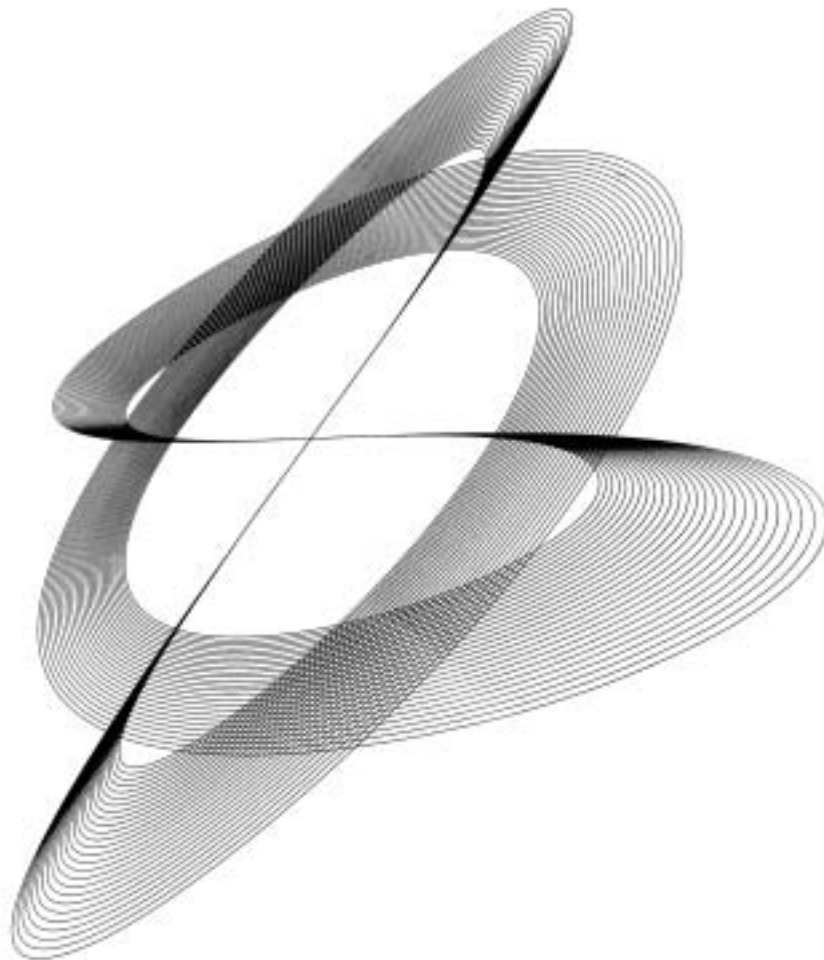
1. Other Catalysts

Automotive catalysts : (Jointly with Umicore group)

Treatment of CO, HC and NO_x in automotive exhaust gas

Process catalysts:

Various process catalysts for oxidation of hydrocarbons such as for Acrylic acid Maleic anhydride and Ethylene oxide productions



Notes:

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