VOC Abatement for Semiconductor plant & IAQ improvement in Cleanroom
Company Profile
HI-PANEX-ION  Ion Adsorption Total Heat Exchanger

DRY-SAVE  Desiccant Dehumidifier

Sky-SAVE  VOC Concentrator

HONEY-SAVE  Functional Filter
Fundamentals on VOC concentrator rotor
Mechanism of Bad affect to Human

Sun, UV

Photochemical Reaction

+ NOx, SOx

Photochemical Oxidant

SPM

VOC
VOC Concentration system flow

Basic design of VOC concentrator

VOC concentrator PURO-SAVE consists of a VOC rotor, a rotor driving device, a rotor casing with a set of seal, a pair of chamber(front/rear) with a zone partition wall, and a desorption heater.

High Concentrated VOCs are Oxidized and harmless.
Operation principle

1. Process
2. Desorb
3. Cooling

Process → Desorb → Cooling
Operation principle

Concentrated
100 Nm3/min
Conc.: 2850ppmC

Process gas
1000 Nm3/min
Conc.: 300ppmC

Purified gas
1000 Nm3/min
Conc.: 15ppmC

Conc. ratio
= process air V / concentrated air V

Heater
200℃

1. Process
2. Desorb
3. Cooling
Model number description

UZ U III – 2450 V40 - H

① Description of rotor
UZ: Hydrophobic zeolite for VOC

② Description of commodity
U: Chamber unit
C: Cassette

③ Zeolite type
I: UZ-I type
II: UZ-II type
III: UZ-III type
V: UZ-V Type

④ Rotor diameter
from 1220 mm to 4250mm

⑤ Rotor depth
40: 400mm
50: 500mm
60: 600mm

⑥ Options
C: Low silicone
H: High Temp. desorption
R: Replaceable type
S: Stainless Steel
High concentration ratio operation
VOC rotor for Semicon & TFT-LCD

Until 2007, Old type was mostly used.

But, New type is now being recommended.

Background:
New type is more appropriate for semiconductor & TFT-LCD.
VOCs included in exhaust gas from Semicon & TFT-LCD

PGMEA
PGME
IPA
Acetone
Cyclohexanone
HMDS
MAK
DMSO
Ethyl lactate

Molecular size is smaller, boiling point is lower

It used to be difficult to achieve higher removal eff.
High Temp Desorption
(Always at 300 degC)
Issues of normal operation with 180 – 200deg C desorption temp.

- **Common performance**
  - Unable to apply higher concentration ratio.

- **Lower conc. exhaust**
  - Unable to apply higher conc. ratio
  - Fuel needed

- **High Boiler VOC**
  - Unable to desorb sufficiently
  - Unable to use

* VOC with BP at 220deg C or higher
Higher temp. desorption demand

Desorb at 300deg C normally

- High performance
  - Higher performance acceptable.

- Lower conc. Exhaust
  - Higher conc. ratio
  - Less or no fuel

- High Boiler VOC
  - Able to desorb
  - Able to use, Longer life

* VOC with BP at 220deg C or higher
Schema for normal 300deg C desorption.
Test (High BP VOC desorption)

Diethylene Glycol Monobutyl Ether Acetate

Spray this VOC onto Rotor

C10H20O4
M.W : 204.26g
B.P : 245deg C
Summery of 300degC desorb

By normal desorption at 300degC

- Higher efficiency VOC removal
  ⇒ Efficiency can increase
  (depends on kinds of VOC)

- Higher concentration ratio for lower inlet conc.
  ⇒ Able to concentrate higher for inlet 50-100ppm.

- Treat on High boiler VOC
  ⇒ Confirmed to treat VOC with B.P. 245degC.
VOC concentrator unit inside clean-room
Conventional system

(Clean room for SEMICON or TFT-LCD)

- Oxidizer + Concentrator
- From local exhaust
  VOC Conc.: 30 ppm or more

Cleaning
Resist Coating
Etching

A/C

Chemical Filter
HEPA or ULPA
Clean Chemical Filter
A/C Air Conditioner

Purified Air
Background

- Low conc. VOC in clean room work area
- Less than 10ppm ~ ppb level.
- Workers sometimes complains the odor.
- Chemical Filter or Activated Carbon is normally used.
  But Frequent replacement required.

=> High running cost, maintenance cost.
Background

• Concentration of Filter outlet contaminants are not constant due to its saturation.

• Periodical maintenance is required. Filter replacement requires process suspension.

• Face velocity for these filtration is limited. So large space is required for such equipment.
Benefit

Owner Target: Low cost alternative
(Both for initial & running/maintenance)

⇒ VOC rotor instead of conventional carbon /chemical
⇒ No frequent replacement is required
⇒ Concentrated VOC to be treated by larger VOC rotor & RTO.

Considerable application

1) To remove low conc. VOC from highly purified room, such as Lithography room ⇒ Refer to Fig. 2.
2) For workers’ health working at clean room every day. ⇒ Refer to Fig. 3
1) Removal of VOC for inside lithography room

- Oxidizer with Concentrator
- Purified Air To Atmosphere
- Filter unit could be unnecessary
2) Purification of VOC to improve environment

(Clean room in Semiconductor or FPD Manufacturing Factory)

- Chemical Filter
- HEPA or ULPA
- A/C Air Conditioner

Oxidizer with Concentrator

Purified Air To Atmosphere

Washing
Resist Coating
Lithography
Etching

Purification of VOC to improve environment
Concentrator Flow Diagram (example)

VOC Concentrator Unit

- Concentrated Air To Secondary Concentrator or Oxidizer
- Cooling Air From Clean room
- Process Air From Clean room
- Desorption Fan
- Desorp. Elect. Heater
- Cooling Coil Humidifier
- Purified Air To Clean room via FFU

Options installed by AHU maker.
Features

- For improvement on work environment.

- Out gas (=purified air) quality is strictly controlled.

- PGMEA is not chemically stable. => VOC rotor should not include catalytic activity.

- Mostly this system is required as retrofit. => foot-print is very limited. Larger air-flow and higher concentration ratio are really required to save space.
Thank you very much for your attention!