Development of adsorption thermal storage system utilizing waste heat

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Introduction

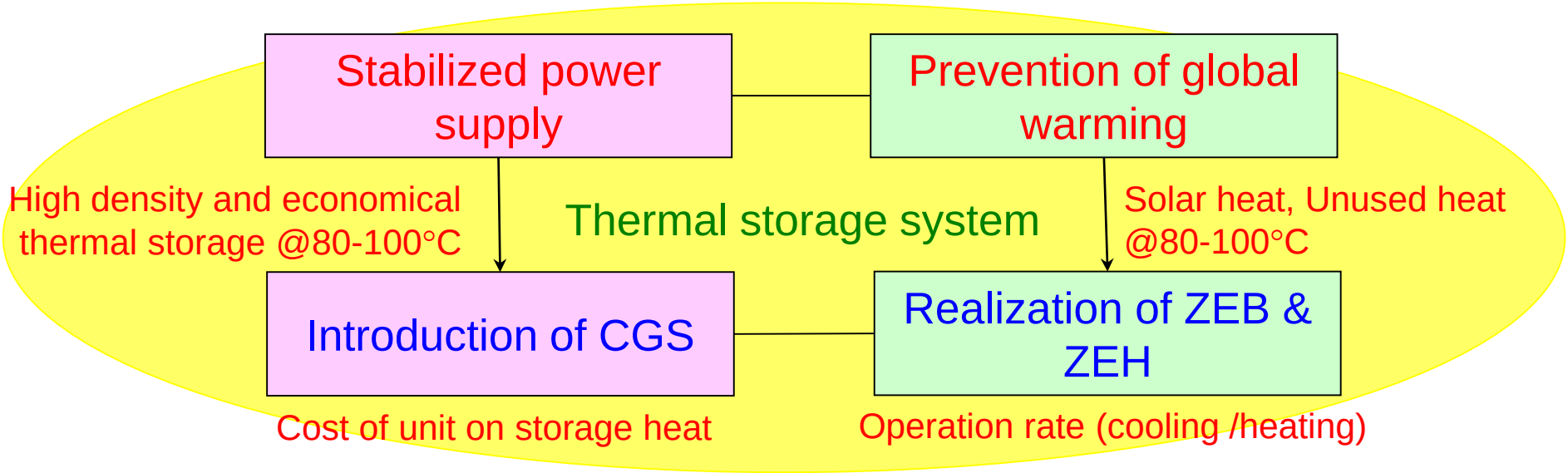
Background and Technical problem on NEDO project

It is necessary,

- saving large energy on realization of ZEB and ZEH for prevention of global warming and stabilized power supply
- Introducing and spreading CGS as a realistic plan for stabilized power supply

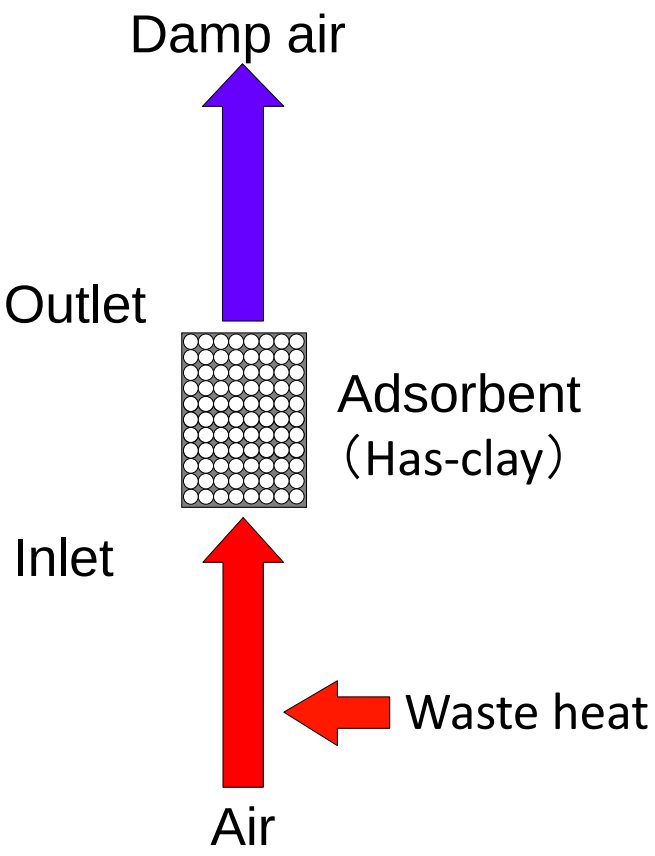
Present Issues

- Utilizations of solar heat and unused heat are insufficiency for economical problem
- CGS is not Introduced without enough heat demand
- Phase change material (PCM) for thermal storage system has Problem of
  1) storage density and cost limited by capacity of solidification latent heat
  2) Using temperature and Operating rate (cooling /heating) limited by melting point



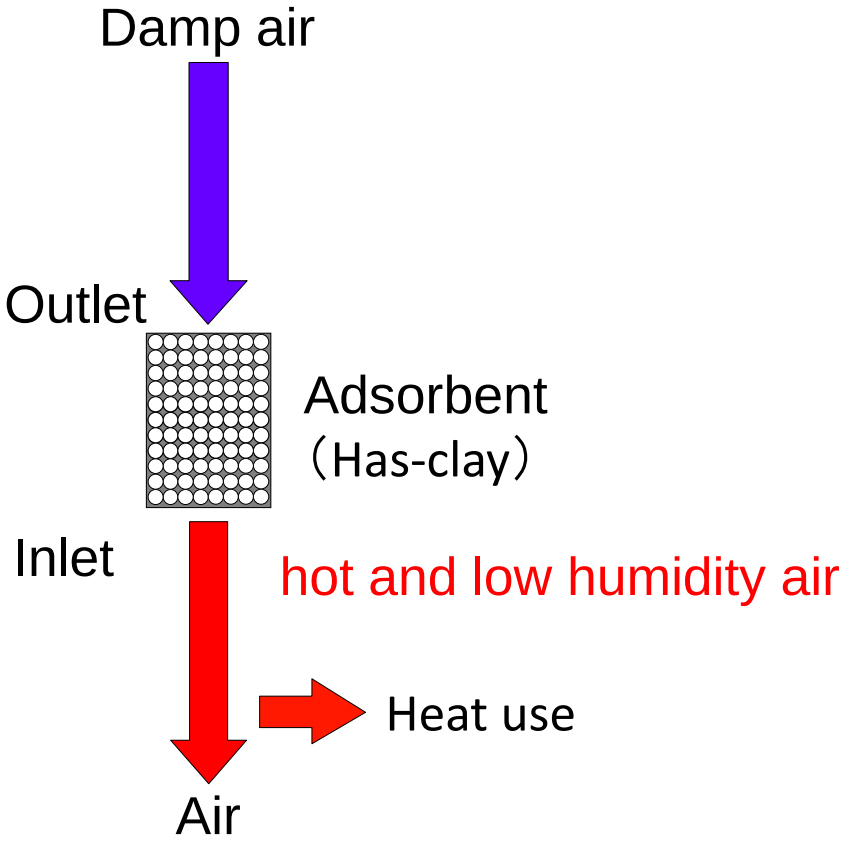
CGS: Co-Generation System, ZEB: net Zero Energy Building, ZEH: net Zero Energy House

Adsorption thermal storage system



Drying adsorbent using waste heat

（a）Charging（desorption）

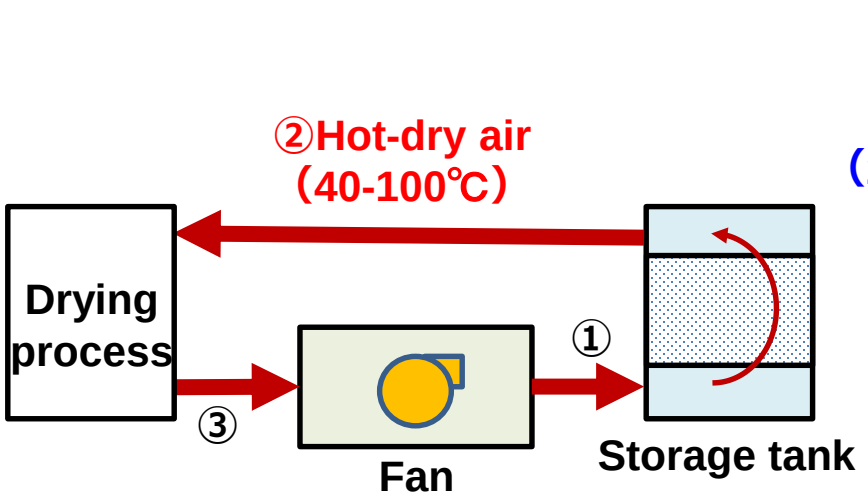


Moisture adheres to adsorbent, adsorpition heat occurs.

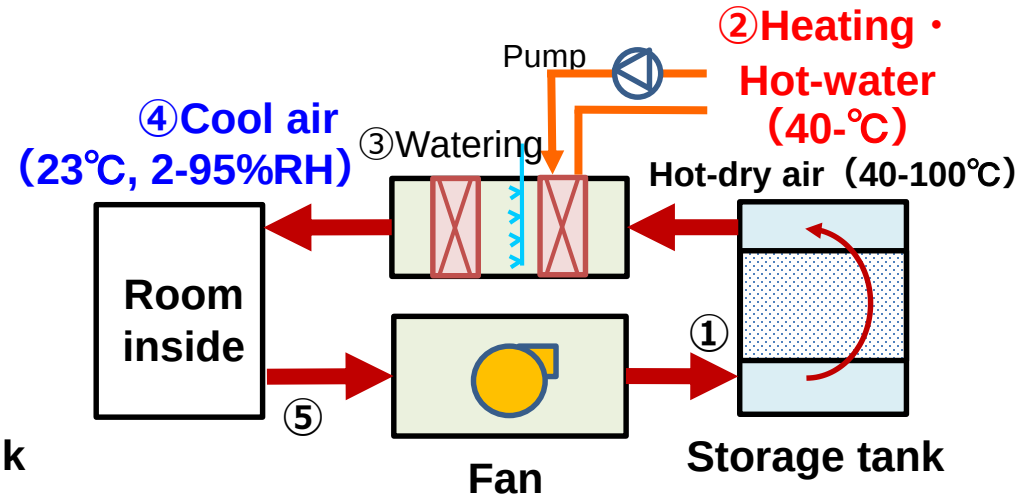
（b）Discharging(adsorption）

Product image of adsorption storage system

- Charging/discharging operation; one-cycle of adsorption type heat pump system
- Cold water by using low humidity air
- Combined use for hot/cooling operation



(a) Drying process



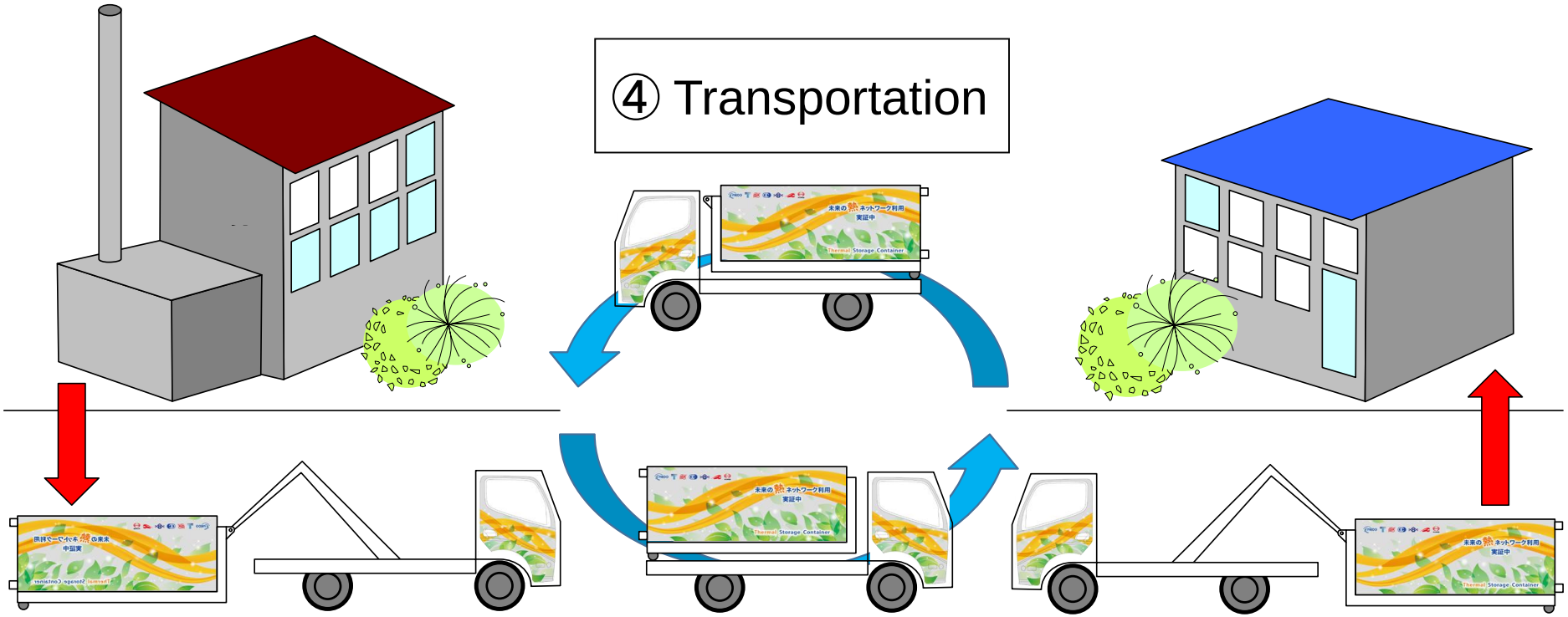
(b) Air conditioning /Hot-water supply

Assumption of Adsorption thermal storage system

The image picture of heat transportation

A Factory
(Charging site)

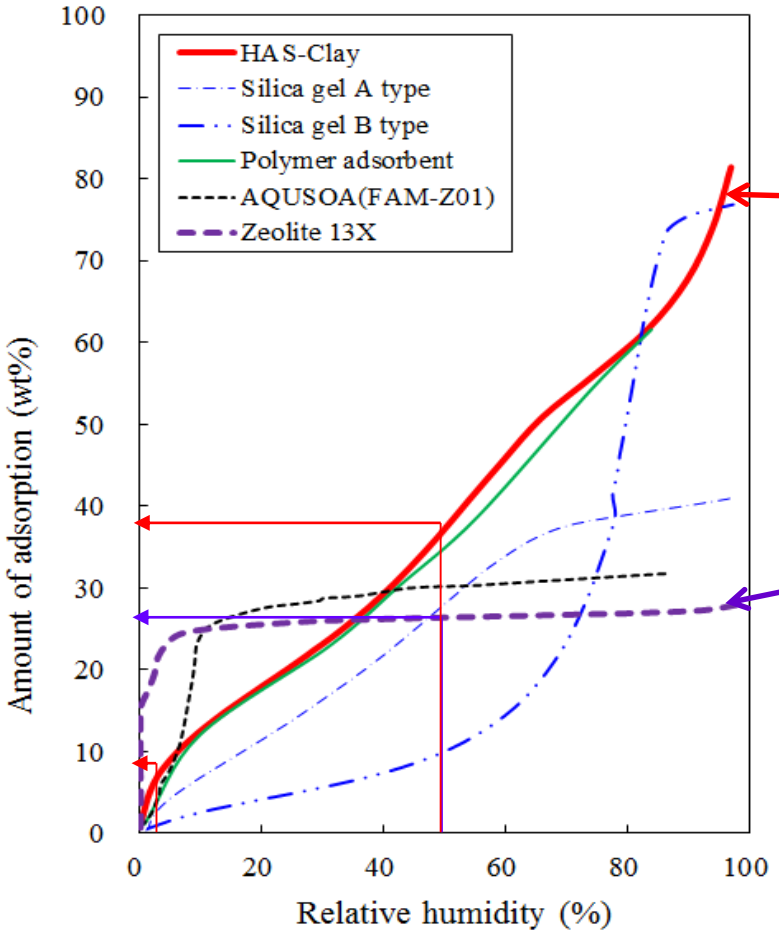
B Factory
(Discharging site)



What is HAS-clay?

・Developed by AIST (National Institute of Advanced Industrial Science and technology in Japan)

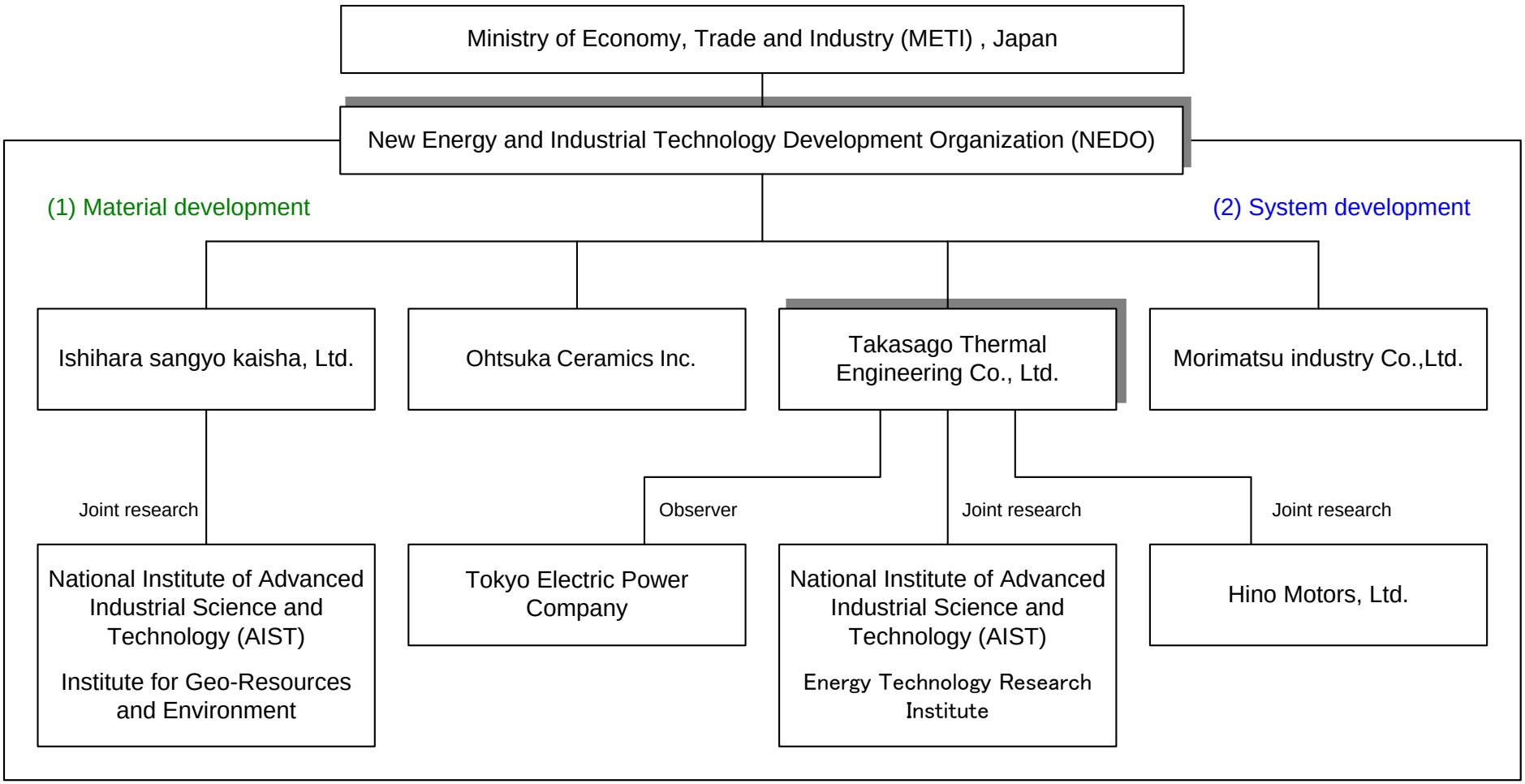
・Complex of hydroxyl aluminum silicate (HAS) and clay minerals on low-crystalline stratified formation



HAS-Clay:
High adsorption performance with wildly humidity condition
Utilization of exhaust heat @80-100°C

Zeolite:
Traditional adsorbent
Over 135°C(135 °C -250 °C)

Organization on Practical use phase of NEDO



Practical use phase @2015/12-2018/3

Development

Material development

Granulated Has-clay

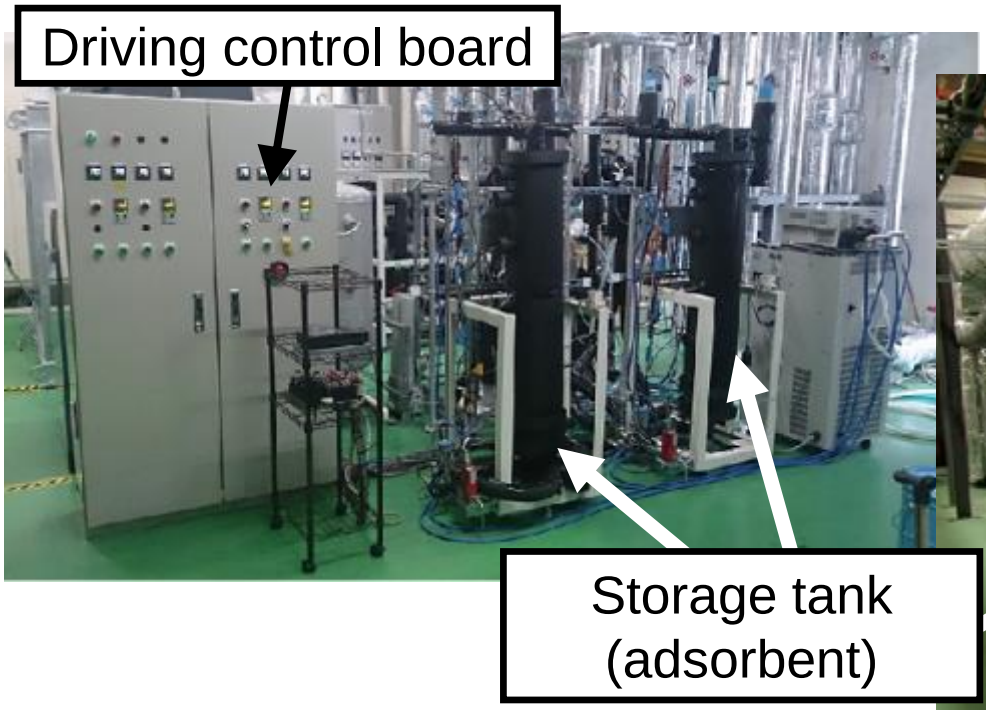
- Thermal density: over **500kJ/Liter**

Mass production equipment

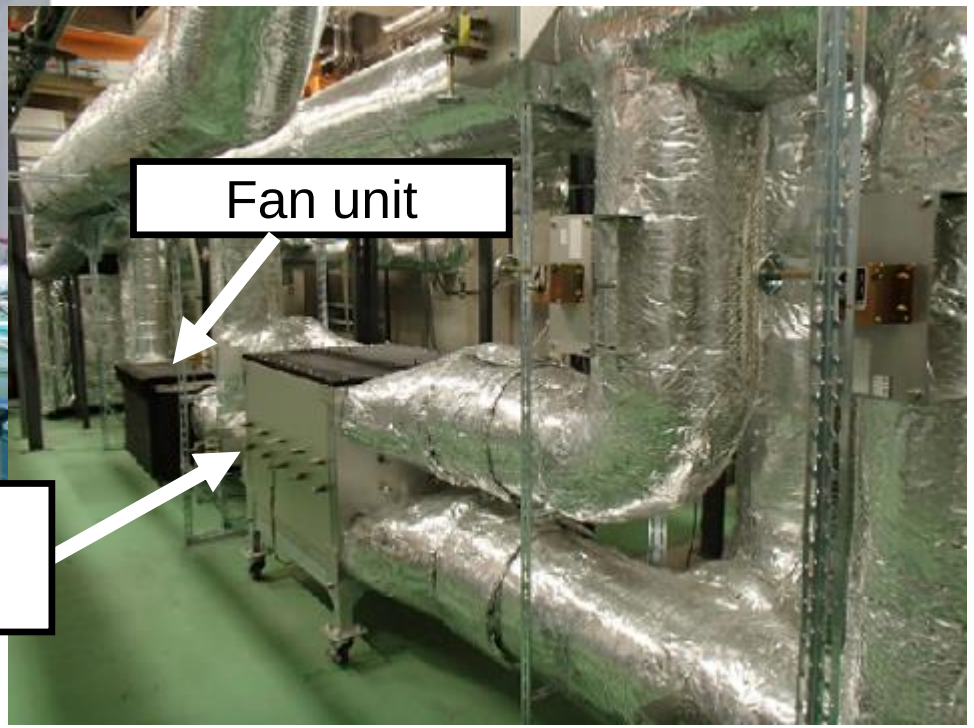
- Thermal storage material cost
  1000JPY/kg@1000ton/year
  on quantity of annual production
  6000JPY/kg@end of practical use phase of NEDO

System development

10kg-class equipment



100kg-class equipment

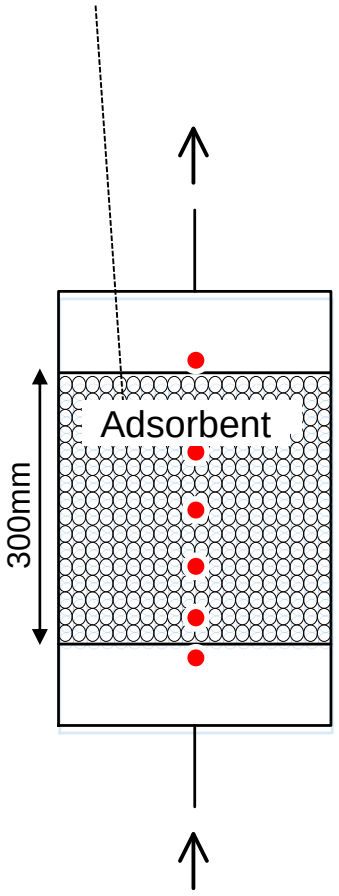


- Collecting performance data of outlet temperature/humidity and mass/heat transfer coefficient for simulation model in adsorption storage tank
- Developed calculation tool

Comparison measurement VS. simulation

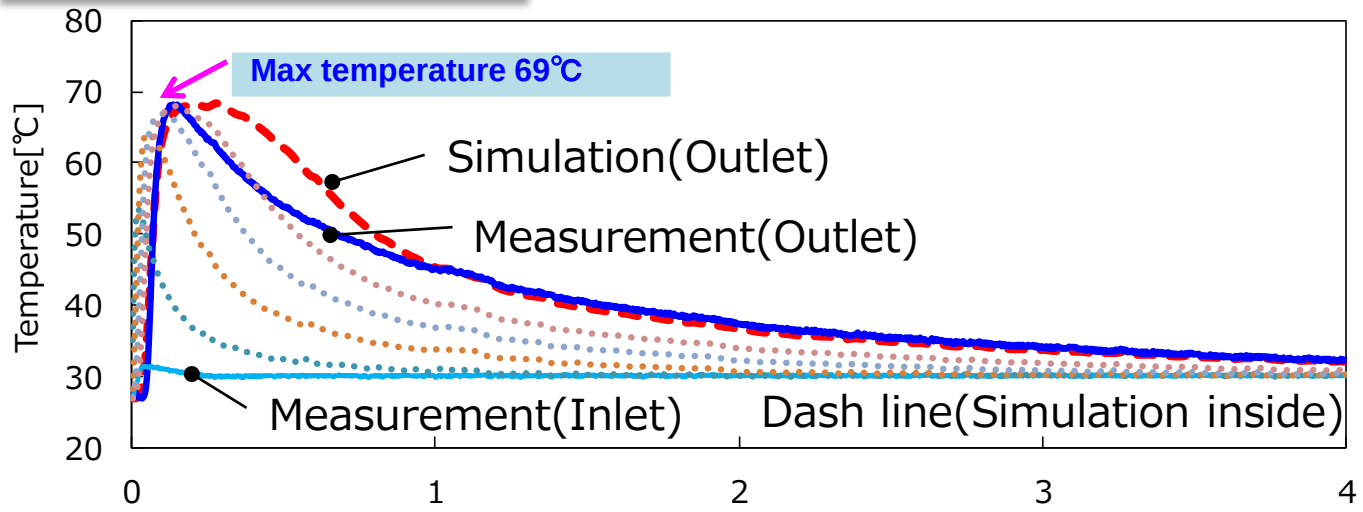
Discharging

After charging
110℃・2%RH
(Has-clay)

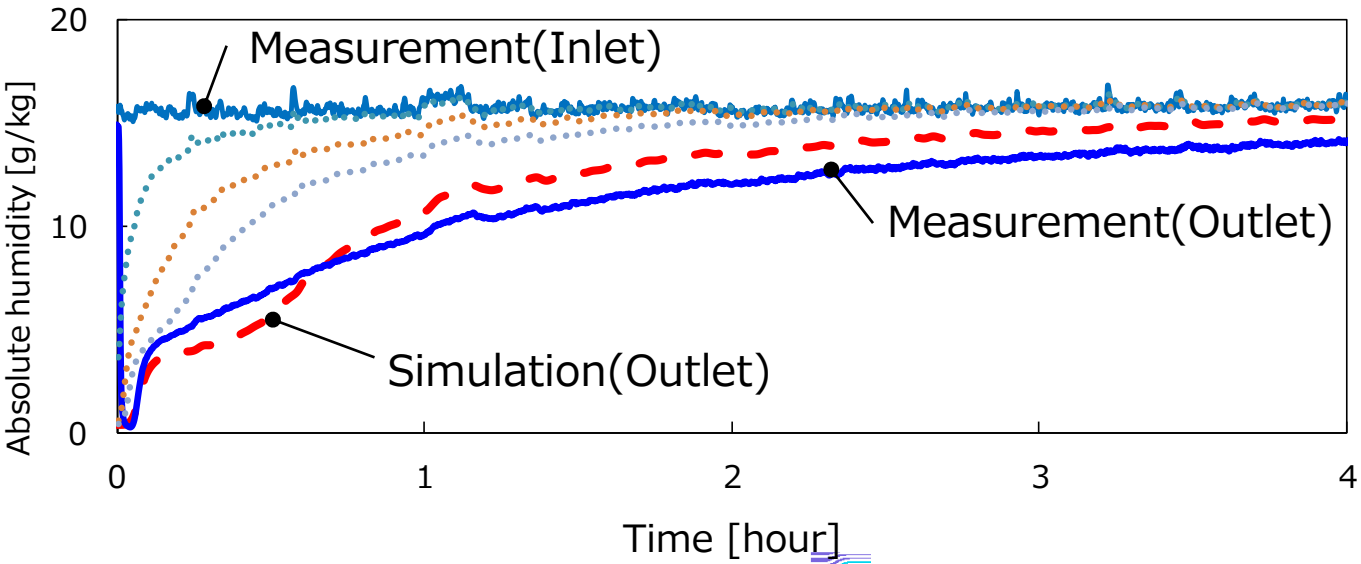


Inlet air
30℃、60%RH

Temperature of air



Absolute humidity of air

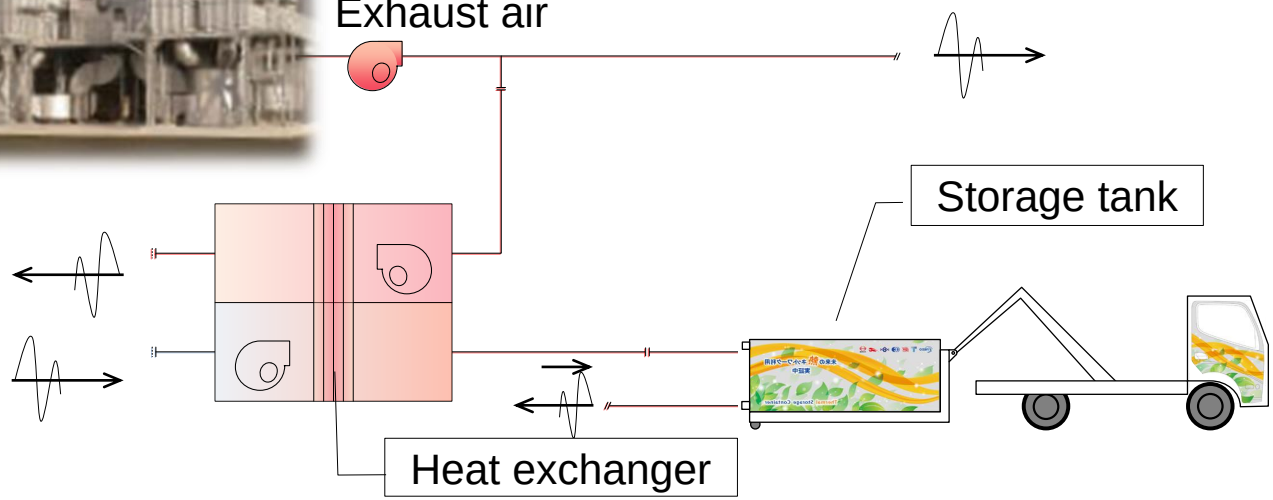


Demonstration

Demonstration plan in Hino Motors, Ltd.

Charging site : Hamura 4th Plant

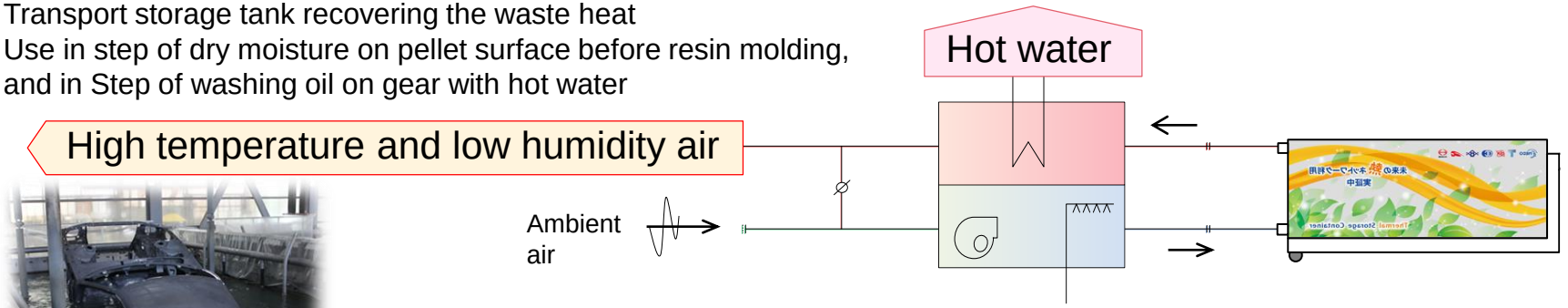
Heat recovery from exhaust of the RTO
in Step of burning VOC contained in exhaust of painting process



Transportation

Discharging site: Hino 3rd Plant and Nitta 6th Plant

Transport storage tank recovering the waste heat
Use in step of dry moisture on pellet surface before resin molding,
and in Step of washing oil on gear with hot water



Charging site : Hamura 4th Plant of Hino Motors, Ltd.

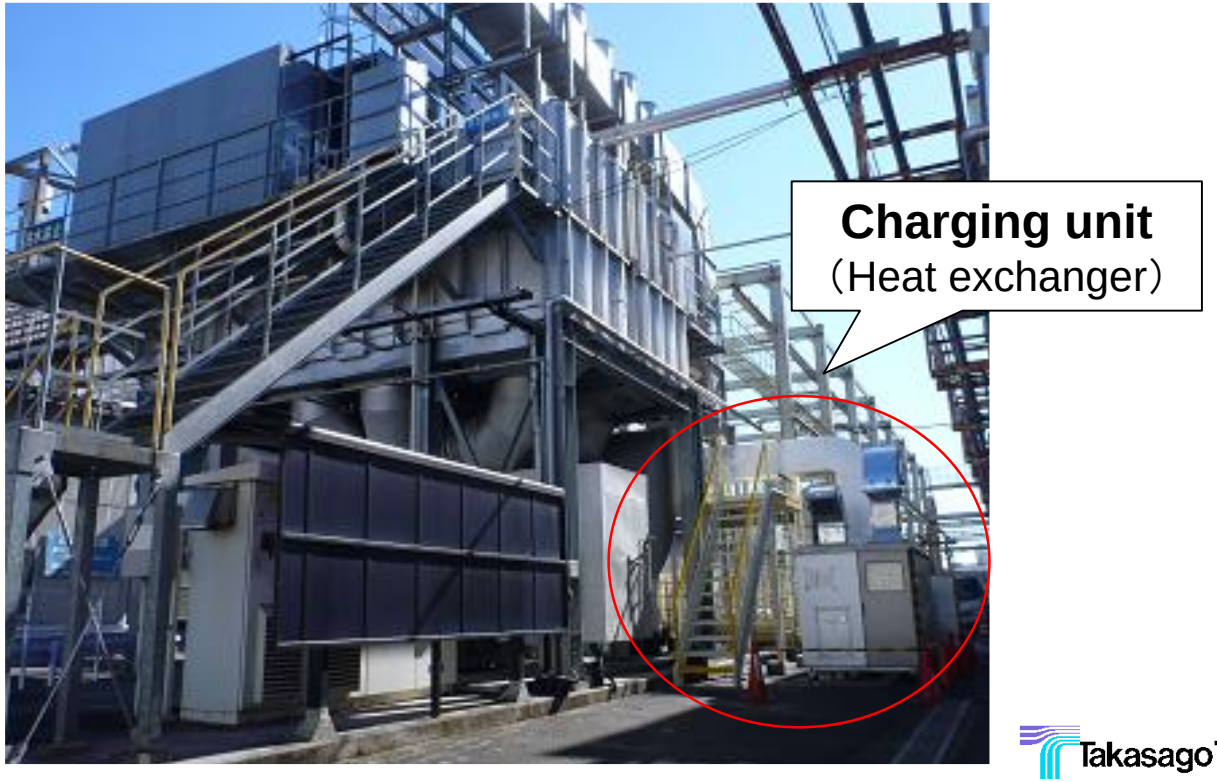
Step of burning VOC contained in exhaust of painting process

Use: Heat recovery from exhaust of the RTO to the Storage tank via the heat exchanger.

(For countermeasures against adhesion of tar, in direct heat exchange.)

RTO : Regenerative Thermal Oxidizer

＜RTO external view＞



Discharging site(1) : Hino 3rd Plant of Hino Motors, Ltd.

Step of dry moisture on pellet surface before resin molding

Use: Directly supply dry hot air from the storage tank.

Task: Confirmation of seasonal impact and its effect.
(especially the rainy season)

Plastic pellet dryer

e.g. Equipment view

Pellet : polypropylene
(Water content : 500～1,000ppm)

Discharging site(2) : Nitta 6th Plant of Hino Motors, Ltd.

Step of washing oil on gear with hot water

Use: Supply of hot water in a wash water tank by heat exchange.

Task: Stably hot water supply (50 ℃ or higher)

Hot water tank：4,000L ×2　50℃

e.g.　Equipment view

Summary

(1) Material development

- Thermal storage material cost: 1000JPY/kg @1000ton/year on quantity of annual production, and 6000JPY/kg @end of practical use phase of NEDO
- Thermal density: over 500kJ/liter on experimental apparatus

(2) System development

- Collecting performance data of outlet temperature/humidity
- Evaluating adsorption thermal storage system by the demonstration in Hino Motors, Ltd.
- Thermal density: over 500kJ/liter with 100kg and 2ton-class equipment

We are planning verification test for 1-2 years with 7-10ton-class equipment.

This outcome was obtained as a result of the help business of NEDO.
We thank relations.

NEDO