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An adventurous boy who started a venture business

"Venture president Kuma and adventure boy"Revised and expanded edition

Founder of Seibu Giken Co.
20 years with President Toshimi Kuma
27 years afterwards and towards the future
And starting a venture

G.V.Lab. Hiroshi OKANO

Global Volunteer Lab.

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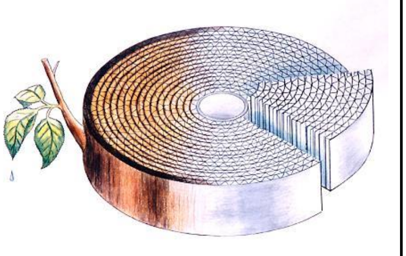


I have been with Seibu Giken for 42 years this year, and I am 65 years old, which is my executive retirement age. I do not like to talk about myself or my past. This is because it leaves a bad aftertaste, as if I have told a boastful story that the other person does not want to hear. Recently, however, I have begun to talk a little more about the company's founder, President Toshimi Kuma, and his battles in development, whenever I have the chance, because I believe that I have a responsibility to pass on to future generations the history of the company. I have been compiling this story little by little for the past two years, thinking that now is the right time to do so as I step down from the board of directors. This story covers the 20 years since I joined the company, during which time I worked with the founder, President Toshimi Kuma, and after his passing, I worked to resolve various internal issues to stabilize the company under a new structure, and at the same time, I worked on development themes and aimed to commercialize products as the founder's last wish. We would like to preserve the founder's image, spirit, and the DNA of Seibu Giken for our current employees and future colleagues. I will also touch on the worries about what to do with the development theme after the charismatic founder's death, as well as the trial-and-error process of searching for a future development theme.

First, I will explain the honeycomb adsorbent application technology that is now the core technology of Seibu Giken.

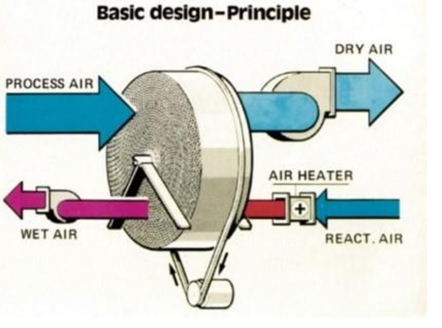
I drew this picture, inspired by a visit to Heidelberg Castle in 1987 after I had developed and commercialized the SSCR. I imagined the honeycomb absorbing water from the ground and releasing it into the atmosphere.

From now on, this stump will absorb CO2 from the atmosphere.

The honeycomb rotor total heat exchanger and dehumidifier are
Invention by Mr Munters (left), circa 1960

On the right is the vice-president
Also visited seibu Giken

Other inventions.
Absorption chillers
Cooling towers
Vaporising humidifiers



Total heat exchangers and dry dehumidifiers that apply honeycomb rotors were invented by Mr. Carl Munters of Sweden. The rotor is made of asbestos paper honeycomb impregnated with water glass, neutralized and solidified with calcium chloride solution, and finally impregnated with lithium chloride. Rotors for total heat exchangers are impregnated with a small amount of lithium chloride to add latent heat exchange performance so that they do not become sticky due to moisture absorption when left in the air. Rotors for dehumidifiers are impregnated with more lithium chloride than total heat exchanger rotors to add dehumidification performance.

At the time I joined the company, there was a Φ500 Munters rotor at the Hakozaki headquarters. The honeycomb was magnificent and seemed like a state-of-the-art technological object from another world. At the time, I had no idea that a few years later I would develop the world's first innovative silica gel honeycomb rotor, the SSCR, which would surpass the Munters rotor.

Betting on recovery from the oil shock

Total heat exchanger development and commercialisation underway

No plant, no people, no money, no nothing. In 1978, a joint venture, Nippon Thermo Lang Co Ltd, was established with Nittetsu Mining Co Ltd to expand the business, but this turned out to be a major miscalculation...

The situation of Seibu Giken just before I joined the company. The oil crisis put the company's business in jeopardy, and the plant staff was restructured.

Survival depended on the development of total heat exchangers. Although the timing of the expiration of Munters basic patent rights may have been a factor, we set our sights on domestic production of total heat exchangers, an idea that President Kuma had been developing since his university days. With the help of a technical improvement subsidy from the MITI* and a loan guaranteed by the Research and Development Center of Japan, we succeeded in commercializing the product in 1975 and began selling it, while our business was expanding.

The response to the domestic production of total heat exchangers was great, and we obtained several distributors, but we lacked the factory, funds, sales force, people, and, in the words of President Toshimi Kuma, "everything" to mass produce total heat rotors in earnest. At that time, Nittetsu Mining, with whom we had started joint research in 1977, approached us about establishing a joint venture company. Ltd. was established in 1978. However, even though we finally overcame the oil crisis and developed a new product, "Thermo-Lunge," another crisis loomed.

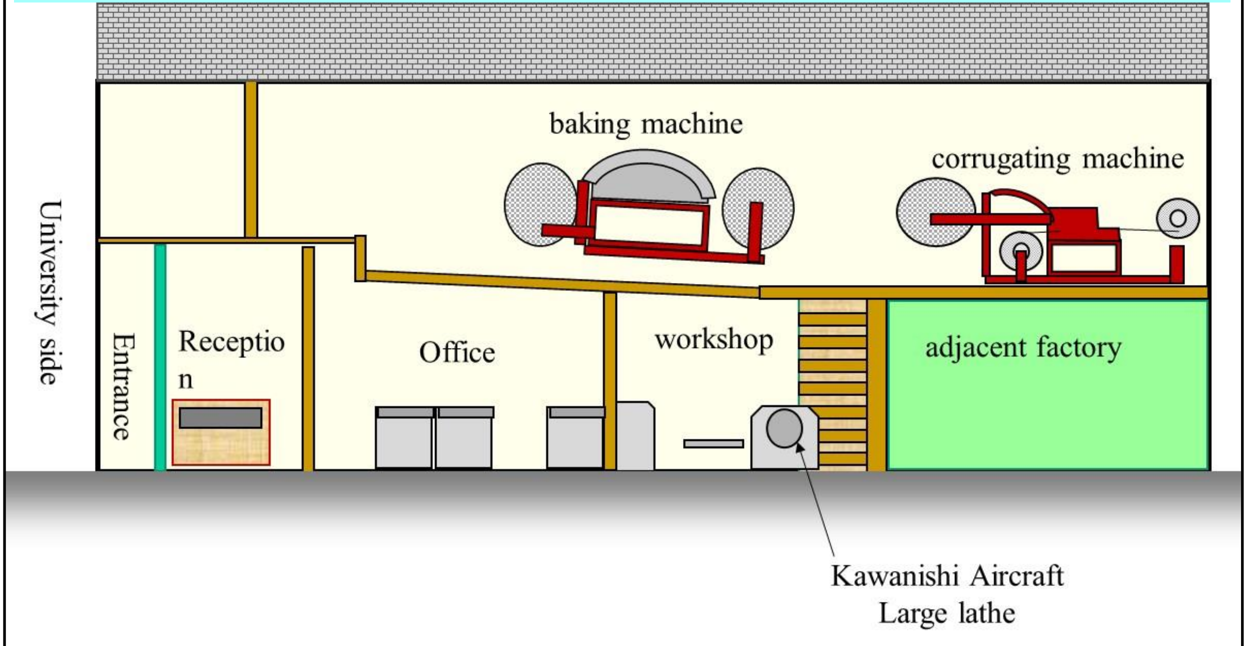
＊ MITI : Ministry of International Trade and Industry

Seibu Giken headquarters in front of Kyushu University, circa 1977. Side view

When I joined the company in 1977, the headquarters of Seibu Giken was located next to the Faculty of Engineering of Kyushu University. The building that housed Seibu Giken and the houses around the company are gone, and the site is now a parking lot.

The corrugating machine was located at the head office. Large-scale equipment such as rotor winders, chemical processing tanks, dryers, and polishing machines were located in a factory far away. Corrugated products of about Φ800 x 230 wide were manufactured at the head office and transported by truck to the factory, taking more than an hour each way, to produce rotors. The factory was located far away from the main office. Even so, the ceiling height was not high enough to produce large total heat exchanger rotors. The factory could only produce rotors up to Φ2000. For rotors with a diameter larger than Φ2000, the factory produced perimeter blocks, assembled the perimeter blocks at the cassette subcontracting plant, assembled them into large rotors with a diameter of Φ2000 or larger, and then assembled them into cassettes.

Seibu Giken head office in front of Kyushu University, circa 1977.   Indoor image



The building that housed Seibu Giken was formerly a warehouse. In the machine shop, there was a large lathe marked 'Kawanishi Aircraft Co., which allowed the company to process and repair simple parts themselves. On the second floor there was a corrugating machine.

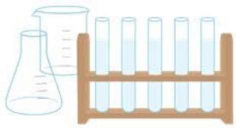
One day, President Kuma instructed me to clean the gears while processing corrugates, and I accidentally bit an iron bar into the gear and deformed it. President Kuma scolded me severely. A senior employee followed up by saying that he was lucky he did not injure his finger. However, later President Kuma himself was seriously injured by the gear. The safety system had not yet been fully established.

For the rotor prototypes, cardboard products processed at the head office were transported to the factory, prototypes were made overnight after the end of factory production, and shipped out the following afternoon.

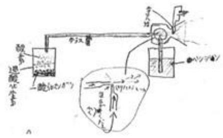
Kawanishi Aircraft : Manufacturer of the famous fighter aircraft N1K2-J “Shiden Kai” and flying boat H8K “Nisiki daitei”

2.Adventure boy

Japanese Viking　Home of the `Murakami　suigun`



Experiments in electrolysis



Conceptual diagram of a rocket engine.

Before I tell you how I came to work at Seibu Giken, I will tell you about my childhood. This is because I believe it will help you understand the connection to my subsequent work at Seibu Giken.

I was born on Innoshima Island in the Seto Inland Sea. Innoshima was once the home of the Japanese Viking Murakami Suigun. Now it is a 46Km link connecting seven islands with eight bridges, and is especially famous among cyclists.　The shipbuilding industry was prosperous at that time and there were several large and medium-sized shipyards.

When I was in early elementary school, I loved to read science illustrated books with excitement, so I was very knowledgeable about things in my neighborhood and at school.　I used to play with wood, bamboo, and other materials close at hand to make all sorts of things.　We were doing experiments on electrolysis, and my brother bought me test tubes and other experimental equipment. I remember being impressed by the beauty of the crystals of metallic salts created by the electrolysis reaction.　I made all kinds of things.

When I was in junior high school, I bought some reagents and tried to make an individual fuel rocket, which exploded and seriously injured both my hands.　I was an extraordinary adventurous boy, making strange things and playing dangerous games.

At that time, Seibu Giken was founded as "Seibu Gijutsu Kenkyusho" and was developing and selling heater products.

senior high school student

High school students Practical training in shipyards

university student

Scientific and technological sports archery

I am the youngest of four sisters and brothers. My mother died when I was very young and I was raised by my grandmother.　I love machines, so I enrolled in a high school that had a shipbuilding course in the mechanical engineering department.

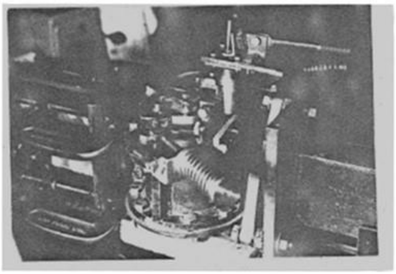
I became interested in motorcycles, and my chicken coop became a motorcycle repair shop, where I bought broken motorcycles at a discount, repaired them, and sold them.

The photo above right is a picture of my factory training at Hitachi Zosen's Innoshima Plant. Hitachi Zosen came to recruit me, but my father refused, saying that he would send me to college. Did you see some potential in my future?　I then entered the Mechanical Engineering Department of the Faculty of Engineering at Kyushu Sangyo University.　The skills and experience I learned in the mechanical engineering department at high school and university, which enabled me to think and make anything by myself, would be of great use to me after joining Seibu Giken.

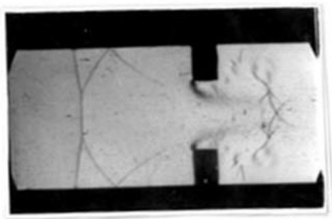
I joined my university's archery club based on my childhood experience of prototyping a handmade bow that could fly a long way.　Archery is interesting in terms of advanced materials and scientific mechanisms such as bows, arrows, feathers, balancers, strings, and sights, and I was excited to pursue archery equipment and training methods.　In my first and second years, we were the sixth lowest ranked team in the Kyushu First Division, but in my fourth year, we won both the Kyushu League and the Intercollegiate Championship.　The secret?　The secret was to raise the level of our lower-level players, including alternates. Good players compete with each other and grow together.　Now that I think about it, this experience was useful when I became a plant manager.

Graduation thesis at university Ito Laboratory
Development of shock wave generator valves

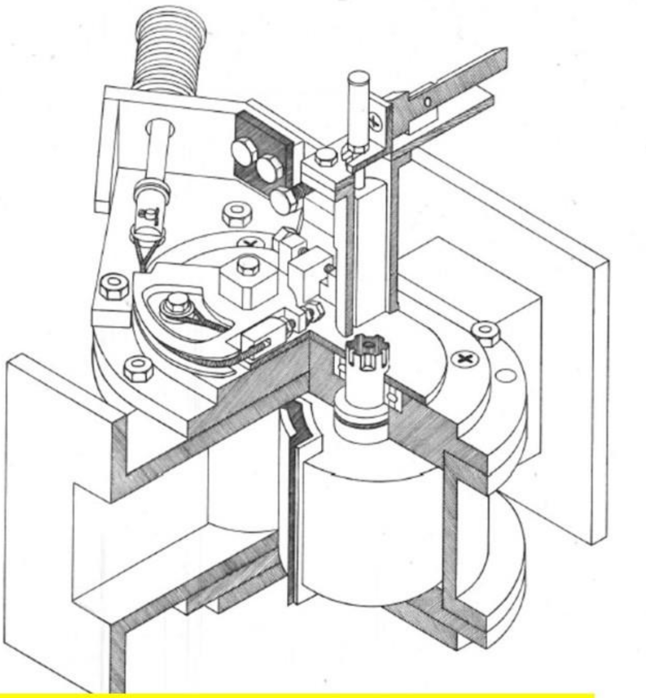
Realising my potential



Prototype valve under experimentation



Shock waves generated by the prototype



Graduation thesis supervisor (student of President Kuma) introduces Seibu Giken

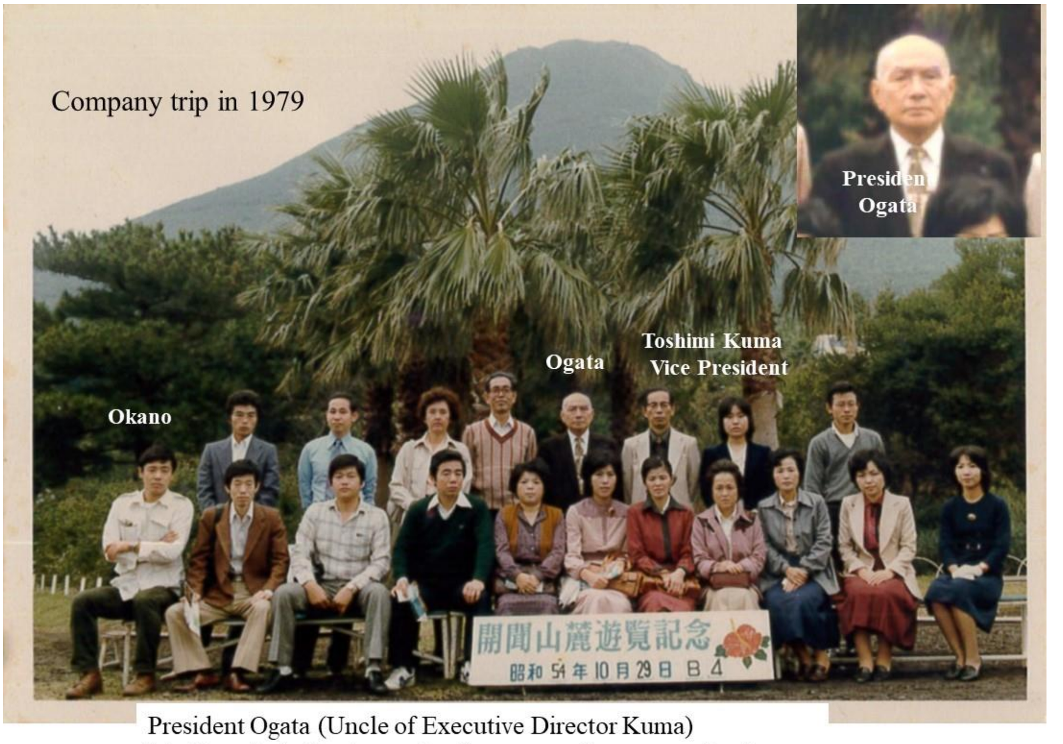
When choosing a theme for my graduation thesis, I was excited by the key phrase "development prototype of XX" and joined Associate Professor Ito's laboratory in the Fluid Laboratory, which led me to join Seibu Giken.

The prototype of a shock valve for a special wind tunnel that generates and shoots Mach shock waves was a difficult problem that the previous two generations of seniors had been unable to prevent even from leaking.

I was excited to put my ideas together and design it. We students rented a factory at the university and handcrafted everything from gas cutting, grinding, and surface finishing of materials to lathing of the shaft. We succeeded in realizing a pressure difference of several hundred times between 10 atmospheres on the high pressure side and a vacuum on the low pressure side, and in generating a shock wave by instantaneous opening. This experience made me realize once again that I was suited to work in the development field, where I could create things based on new themes.

I was introduced to jobs at manufacturing companies, but I was not interested in such jobs because I imagined that I would be repeating the same kind of production work. Then I was asked, How about Seibu Giken? The reason was that Associate Professor Ito, who was in charge of the company, was a student of President Kuma.

3. Joined Seibu Giken Co. 1977



President Ogata (Uncle of Executive Director Kuma)
Mr. Kuma's dedication to development and support to banks, etc.
Made efforts to negotiate and deal with Nittetsu Mining Co.

The picture of the scary-looking President Kuma in the company brochure made me a little uneasy, but the excitement of getting a development-related job made me not care about the small size of the company.　I had an interview at the Hakozaki head office next to Kyushu University.　A few days later I joined Seibu Giken.　I was hired as a joint development worker with Nittetsu Mining Co.,.

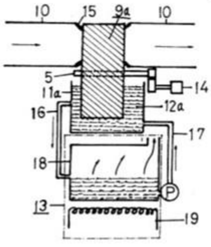
I had been working day and night on my thesis research, so I thought it would be good to get a job because it would free me up and I would get overtime pay for working overtime, but I realized that I was naive.　Although I was paid overtime during my three-month probationary period, I was told when I became a permanent employee.　Development staff will not be paid overtime.　Instead, if they are successful, they will be paid for their success.　In the end, I never received overtime pay after that.　After I got married, I stayed up all night a lot and had some hard times, but I was excited about my work.

This is a picture of the company's 1979 company trip, with about the same number of employees as the year I joined the company.　In that year, the joint venture agreement with Nittetsu Mining and the construction of the new Hisayama plant were being discussed. When I joined the company, Mr. Kazue Ogata, Executive Director Chieko's uncle, was the president.　He was asked to take office at a critical time for the commercialization of the Thermo Lung total heat exchanger, which was a key element in the company's restructuring, so that he could help the management of Seibu Giken and President Kuma could concentrate on development.　He had a background of managing and restructuring a ceramics company, and came to work once a month for a week or so, providing management guidance and negotiating with banks and other institutions. One day he saw my father on TV and said, "Okano-san's father is an enthusiastic agricultural researcher." He introduced me to everyone he met.

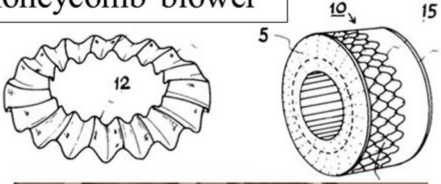
Joint research and development with N company

Theme 2
Wet Rotor Dehumidifiers

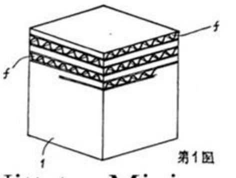
Development of Kuma Patents 1977-1979



Theme 1
Honeycomb blower



Theme 3
Ceramic heat exchanger



Amid sluggish joint development, some at Nittetsu Mining argued that Kuma was unnecessary.

Executive Director H of Nittetsu Mining fell in love with President Kuma's development capabilities and concluded a joint development agreement with Nittetsu Mining in September 1977. Three themes from President Kuma's patents were adopted and development began.

Theme 1: Honeycomb blower development

This was the development of a high-performance, low-noise honeycomb blower based on the infinite blade theory, in which aluminum foil is formed and laminated as shown in the photo. Contrary to expectations, however, it was discontinued when it was found that the countless honeycomb blades increased resistance and noise became higher-pitched.

Theme 2:Development of LiCL Liquid Film Regeneration Rotor Dehumidifier

As a result of Nittetsu Mining Co., market research, this theme was terminated when it was determined that a dry method should be developed from now on.

Theme 3: Development of ceramic high-temperature heat exchangers

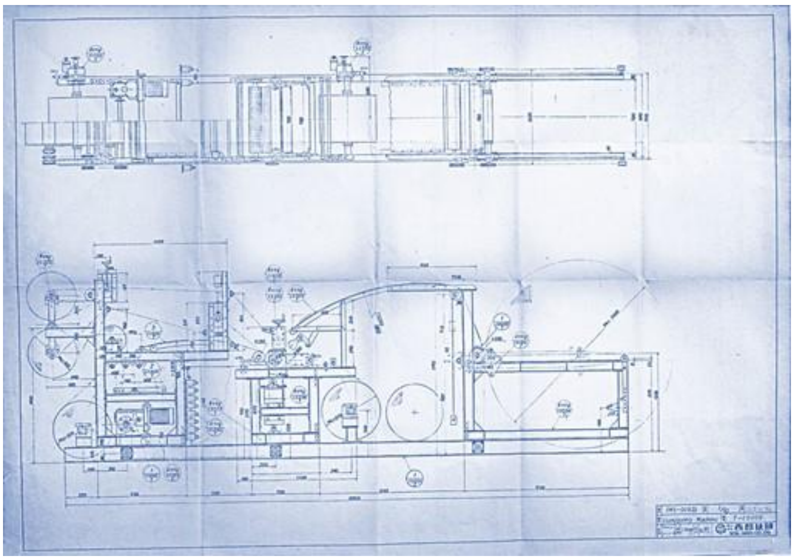
This development enhanced my knowledge of ceramics. However, Nittetsu Mining Co., had developed, before Seibu Giken, paper that could be turned into ceramics by firing, as well as flame retardant paper with asbestos countermeasures. This led to the dissolution of the joint venture, as "Nittetsu Mining had better development capabilities," which led to the "argument that President Kuma was unnecessary."

None of the development themes were successful, but they would later lead to the development of Seibu Giken innovative rotors.

Exported total heat exchanger manufacturing technology to Korea
Responsible for designing the corrugating machine

At the head office in front of Kyushu University in 1979

In 1979, after the joint development with Nittetsu Mining had ended in failure, I was in charge of designing and manufacturing a corrugating machine among various production machines for a technology export to a Korean air conditioner company. Since this technological export was decided before the joint development with Nittetsu Mining, it could be carried out without interference from Nittetsu Mining. Thanks to this, Seibu Giken overcame this difficult period and barely gained a foothold for the next business development. President Kuma's strategy was so ingenious that two sets of machines were manufactured, one set for export and the other set to be used as production equipment for the Seibu Giken new Hisayama Plant. Assembly and shipping of the new production equipment proceeded at the newly built Hisayama Plant.



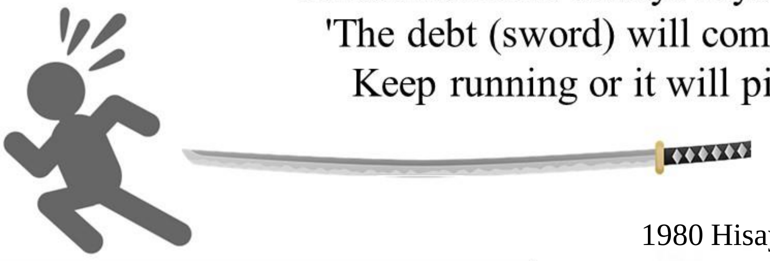
Trial run in Korea

Western Giken is in danger of being taken over!

End of 1981 Joint venture dissolved ⇒ But all sides are blocked

- ■Asbestos rotors not sold due to carcinogenic issues
- ■Newly developed flame retardant paper rotor cannot be made due to contract

President Kuma always says
'The debt (sword) will come after you.
Keep running or it will pierce you."



1980 Hisayama new plant

Slogan in front of the president's office

(Company is next to danger.)

企業は危業

One day after moving to the new plant in 1980, I vividly remember that President Kuma himself wrote in red ink on a large piece of paper above the entrance to the president's office, as shown above. What? I was a young man at the time, and I thought it was just a performance, telling everyone to work with a sense of crisis.

At that time, President Kuma would often say at visitors' dinners, laughing with black humor, "I am chased by the sword (debt), and if I am not constantly running, it will stab me in the back. When I think about it later, all my memories come together to one total point.

Sensing the danger of Nittetsu Mining's attempts to absorb Seibu Giken through skillful negotiations and contracts, President Kuma and Chairman Ogata move to dissolve the joint venture. Nittetsu Mining attempted to constrain Seibu Giken by contract even after the dissolution of the joint venture. Chairman Ogata and President Kuma were desperate to confront the dissolution of the joint venture, which I later learned in detail when I read "The Story of Thermo Lang.

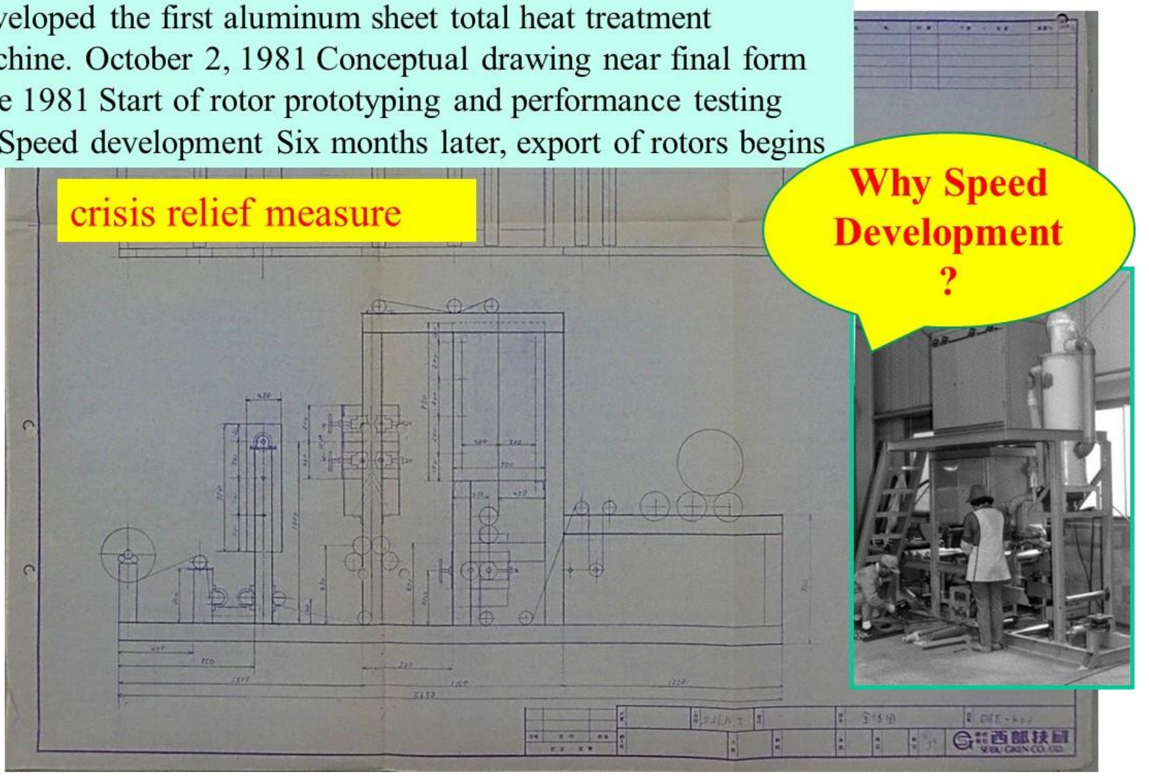
One day, at dinner with Executive Director H of Nittetsu Mining and others, Chairman Ogata said to Executive Director H.

"Please keep your promise! If you break your promise, I will stab you to death! I am an old man, so I don't care if I die in a simultaneously striking each other."

I vividly remember feeling that Chairman Ogata was a samurai.

4. Development of Aluminum Total Heat Exchanger

Developed the first aluminum sheet total heat treatment machine. October 2, 1981 Conceptual drawing near final form
Late 1981 Start of rotor prototyping and performance testing
Speed development Six months later, export of rotors begins



Late in the summer of 1981, President Kuma instructed me, "We are developing an aluminum total heat exchanger rotor, so please think about a machine that mixes silica gel powder with adhesive and coats the aluminum foil.

Other companies also had rotors made of aluminum. For example, we heard that Fläkt rotors were made of aluminum that had been treated with chemicals. B.I.Co., also had an aluminum rotor that was coated with an adhesive mixed with silica gel powder. Although the development and production of flame-retardant paper total heat exchanger rotors was prohibited by contract, President Kuma's idea of making them of aluminum was a good idea.

The development from paper would have required joint development with a paper manufacturer, which would have increased the cost of prototyping, increased the burden of securing inventory and contracts, and taken time for prototyping and evaluation. If the product is made of aluminum, the company can start on a small scale by developing a processing machine and purchasing the required amount of commercially available aluminum foil.

I considered developing a machine to coat silica gel powder on aluminum foil, and in a short time, about six months, I was able to develop a coating machine, conduct performance tests, and commercialize and ship a high-performance total heat exchanger rotor. Do you know why such a high performance rotor could be developed in such a short period of time, about six months?

Why was speedy development possible?

Develop a machine that mixes silica gel and adhesive and applies it to aluminum foil.

September 1981

■How to mix silica gel with adhesive

If the adhesive is too thin, it will peel off.

If the silica gel is too thick, it will block the silica gel.

Performance and Strength Huge amount of time for optimization

What are you going to do? Can you do it?

■How to bond silica gel particles in sandpaper form?

Silica gel performance is undisturbed, strength and performance are produced?

That would cut down on development time!

Analogical thinking

But if you process 2 sides, it becomes a big machine => What to do?

■What if you glue both sides at the same time and spray silica gel particles?

⇒If you pull it up vertically, it will be compact.

■Blowing silica gel particles with a blower => That's it!

When President Kuma instructed me to consider a machine that mixes silica gel and adhesive and applies it to aluminum foil, I considered the possibilities and difficulties. But what kind of adhesive? What is the concentration? What is the ratio of powder? There were so many factors to consider, such as the type of adhesive, the concentration, the ratio of powder, etc. Would it perform well? It seemed to me that the method of mixing and coating would lead to a quagmire of development. What should we do?

Yes!!! Instead of mixing them, why don't we just apply adhesive to the aluminum foil and glue the silica gel particles to it? The adhesive would not be diluted, so the adhesion would be stronger and drying time would be shorter. Also, the surface of the silica gel would not be covered by the adhesive, so high performance would be achieved. We thought it would require less prototyping and performance testing to optimize. However The conceptual diagram of the equipment for coating the front and back two surfaces is quite large. What do we do?

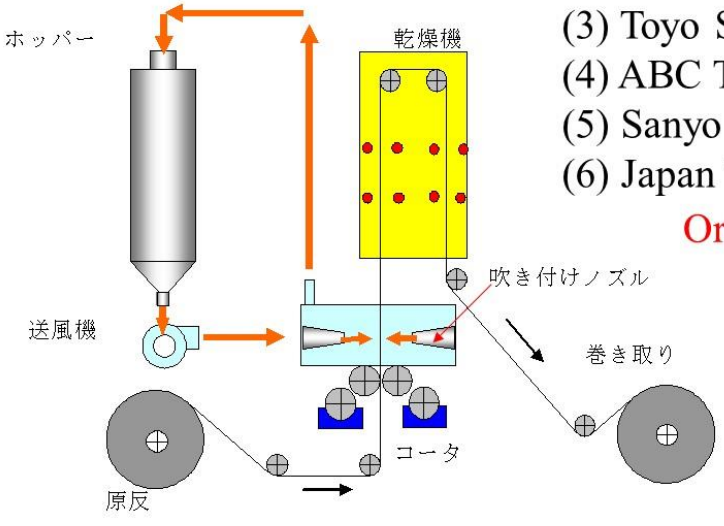
Yes!!! Two sets of adhesive rollers facing each other, aluminum foil pulled up through the gap, coated with adhesive, and sprayed with silica gel from both sides, we can process the back and sides at the same time." After spraying silica powder onto the aluminum foil and gluing it, the sheet was dried while being pulled up, flipped down in a semi-dry state, and then additionally dried and rolled up in a fairly compact manner.

The result was an unexpected effect: the silica gel on the surface absorbed the water, speeding up the drying speed, and even when the material was freshly dried, it did not adhere to the reversing rollers, thus increasing the processing speed. A high-speed mass-production machine could be developed in a few short months.

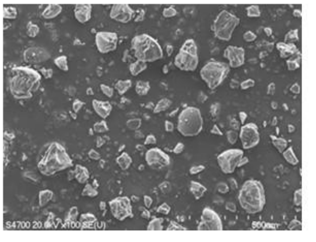
1982 Start of development and shipment Named “HI-PANEX-AL”

Competitors in 1982

(1) Burner International Co.
Munters distributor in Japan
(2)Japan Frakt（ Sweden ）
(3) Toyo Seisakusho Co.
(4) ABC Trading Co.(Import)
(5) Sanyo Electric Co.
(6) Japan Thermo Lang Co.



Original Adsorbent Particles
Spray adhesive type



We re-entered the market with a new product at a time when many companies in the total heat exchanger industry were far stronger than our company in terms of research and development, human resources, capital, and sales.

One day I was called into the president's office and received a compensation for my invention.　I think the invention compensation was about half of my monthly income at the time. I think it was about half of my monthly income at the time, but I think he was very considerate of me at a time when the business situation was very difficult.

Aluminum foil was initially 80 microns, but was changed to 25 microns by order of President Kuma in order to reduce costs.　We thought this was a bad order, but it turned out to be a great success. The cost was lowered without any strength problems, mass production and cost were both improved, and competitiveness was dramatically enhanced.

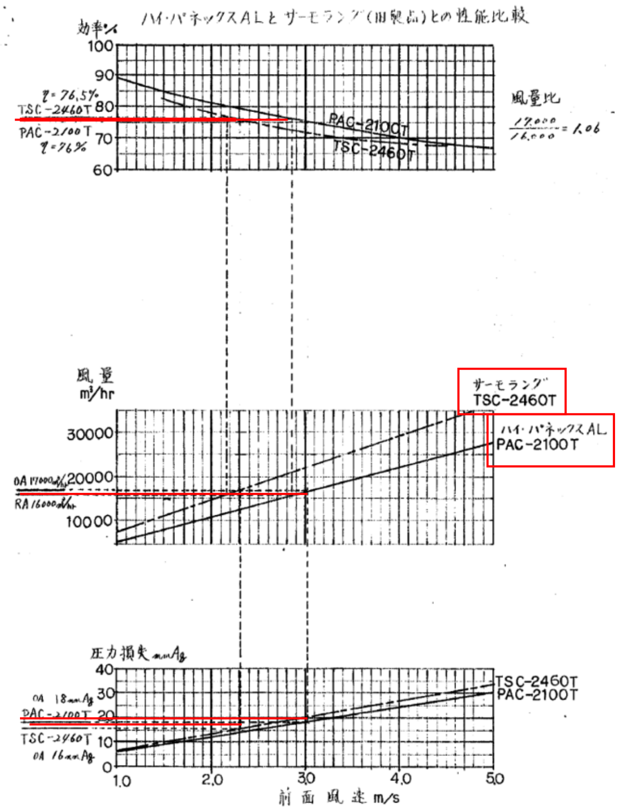
President Kuma and I came up with the name HI-PANEX.

1983 initiation ceremony All 28 employees

The photo was taken the year after HI-PANEX-AL was launched. To the best of my knowledge, this is the first photo of an induction ceremony. I did not have an induction ceremony. Three new employees are lined up next to President Kuma with the newly developed rotor in the background. For a while after the move from the old factory to the new one, half of the female part-timers commuted by train from distant places to help with the production handover training of flat heaters. Thirty-six years have passed since this photo was taken, and as far as I know, at least six of the people in this photo have already passed away.

Far exceeds the performance of the Japan Thermo Lung Co. TSC

Equivalent performance and pressure drop with one rank smaller model

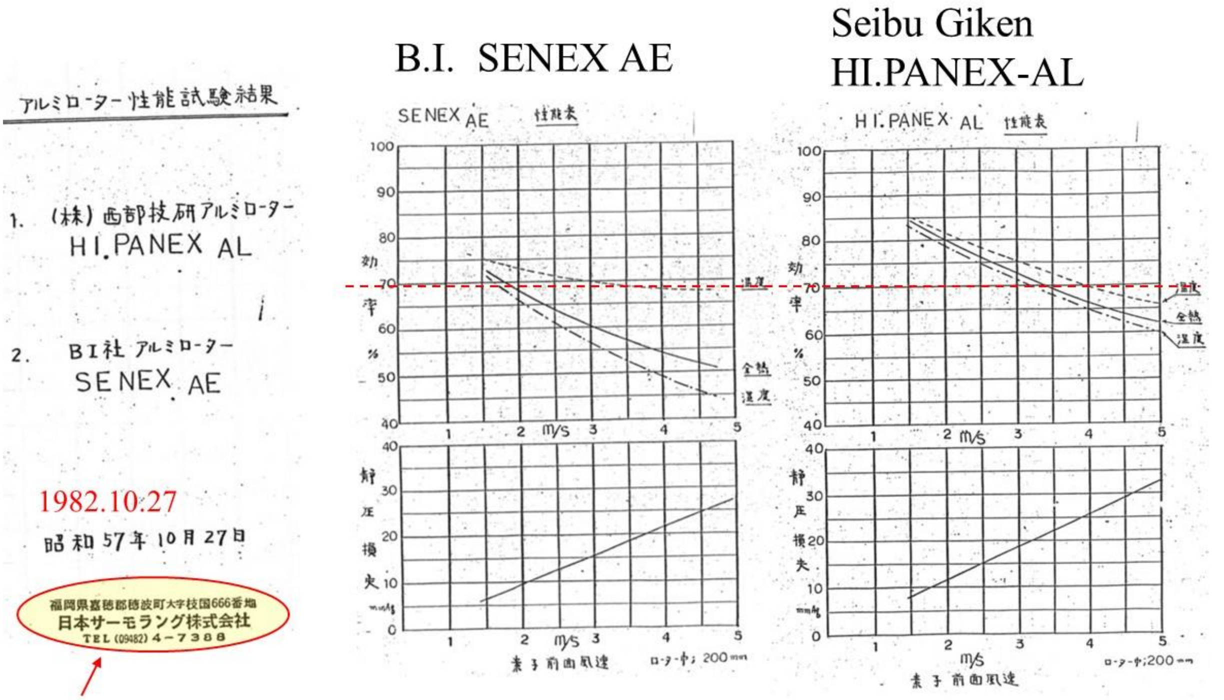


During the development of the aluminum total heat exchanger rotor, President Kuma, who was concerned about the lack of performance, ordered us to conduct a trial test in which the rotor was impregnated with a dehumidifying agent, lithium chloride solution, but we were relieved to confirm that this was not necessary and that the performance was excellent. We were relieved to learn that this was not necessary, because without the need for lithium chloride, the technology would be more technically perfect and there would be no corrosion concerns.

The newly developed HI-PANEX-AL was very high performance, probably due to the original manufacturing method. We prepared a pamphlet comparing HI-PANEX-AL with New Japan Thermo Lung Co. flame retardant paper TSC Rotor, as shown in the above right figure. HI-PANEX-AL is one class smaller than New Japan Thermo Lung TSC rotor, but has the same total heat exchange performance and pressure drop.

One day when Chairman Ogata came to Fukuoka, he was making his rounds of the factory as usual, and upon meeting me, he said emphatically, "You have made a great contribution! “ I didn't know what he meant and didn't pay much attention to it after that. Later, however, when I read "The Story of Thermo Lung" and reconstructed the situation with my memories of that time, I came to realize that HI-PANEX-AL was indeed an up-and-down comeback homerun in the final inning.

Testing and evaluation at Thermo Lung Japan Co.
Superior performance to that of the long-established competitor, B.I.Co.



Dissolve joint venture and competitor

President Kuma selles the newly developed rotor to New Japan Thermo Lung Co. I thought, "Why would we sell a newly developed product to a competitor? However, I think it was a business decision by Seibu Giken at the time that it would be more advantageous to take advantage of the other company's sales force.

Comparative testing of HI-PANEX-AL and Burner International's SENEX-AE was conducted at New Japan Thermo Lang, and the report above confirms that HI-PANEX-AL has superior performance.

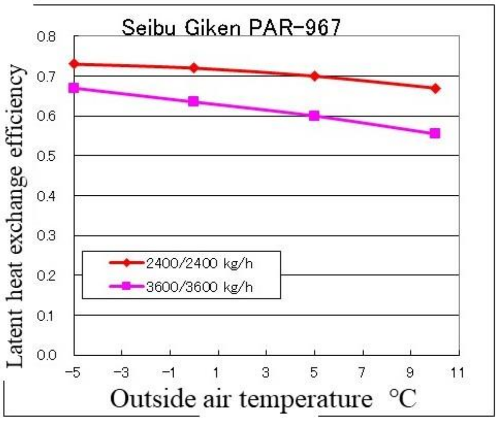
New Japan Thermo Lang Co., Ltd. will purchase "HI-PANEX -AL" from us. They said, "President Kuma, no need," dissolved the joint venture, and less than a year later, we developed a total heat exchanger rotor with far higher performance than any other and had a competitor purchase it from us. I now wonder how President Kuma must have felt when he saw this.

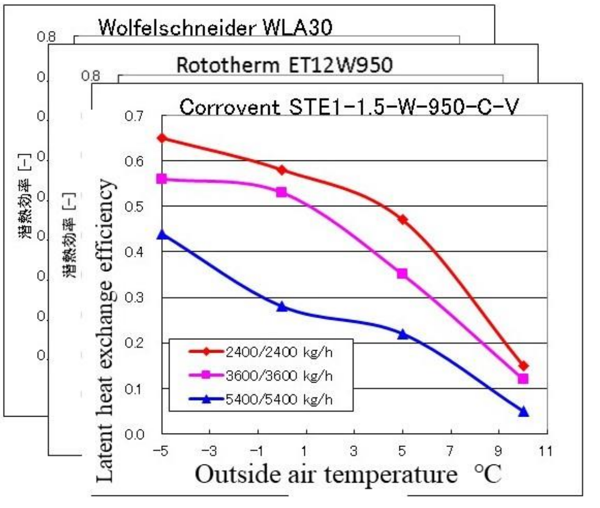
Thereafter, the Japanese total heat exchanger market became a three-way battle between New Japan Thermo Lang co., Nippon Flextronics, and Seibu Giken. However, due to the difference in sales power, the top two companies always stood in front of each other.

High performance evaluation of HI-PANEX by a Swiss research institute

NEFF : National Energie-Forschungs-Fonds

1.Wolfelschneider WLA 30	Aluminium	Germany
2.Rototherm ET12W950	Aluminium	Germany
3.Rototherm PT10W950	Aluminium	Germany
4.Seibu Giken PAR-967	Aluminium	Japan
5.Seibu Giken PCR-967	Ceramic paper	Japan
6.Corrovent ST1-1.5-W-950-C-V	Aluminium	Sweden
7.Corrovent STE1-1.5-W-950-C-V	Aluminium	Sweden





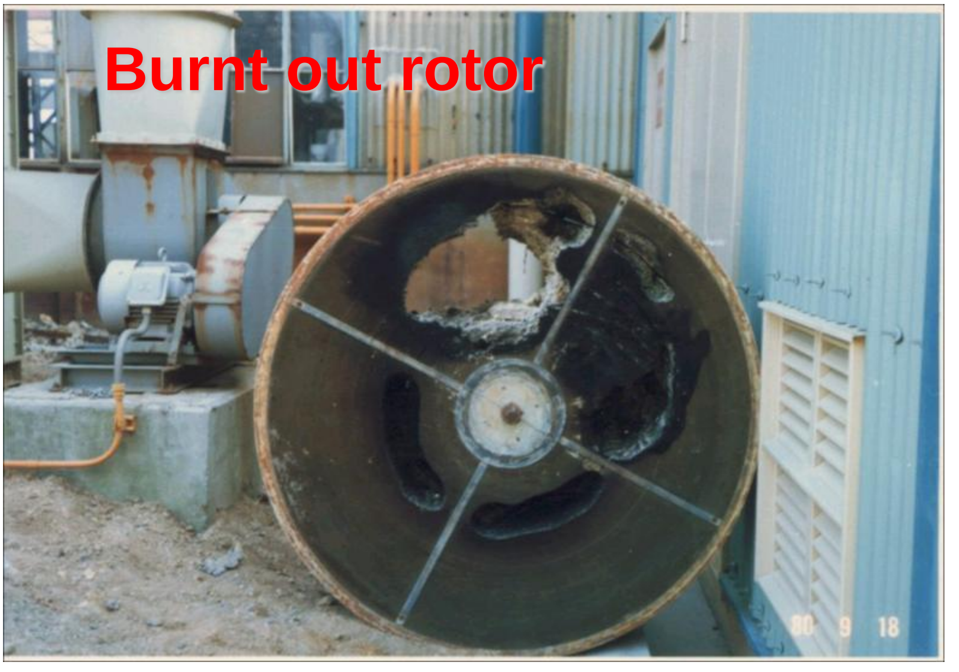
One day, about 20 years after the commercialization of HI-PANEX-AL, NOVENCO came to our office with a test report from NEFF. NOVENCO had adopted many other total heat exchanger rotors for cabin air conditioning on luxury cruise ships traveling the world. However, there were complaints of poor latent heat exchange performance, and they were looking for a rotor with good latent heat exchange performance.

While searching for a rotor with good latent heat exchange performance, they found a test report by NEFF and contacted SG.

As shown in the upper right figure, other companies' rotors have good latent heat exchange efficiency due to the condensation phenomenon inside the rotor when the outside air temperature is low, but when the outside air temperature becomes high, the condensation phenomenon decreases and the latent heat exchange performance drops drastically. In this respect, HI-PANEX-AL demonstrates high latent heat exchange efficiency even at high outside air temperatures, as shown in the left figure, and this is why NOVENCO decided to purchase SG rotors. At that time, about 100 units were delivered for four vessels.

5. Development of SSCR

Developing the world's best rotors beyond repeated complaints



1980 Electromagnetic Steel Plate Company 2nd claim

I was in charge of the second rotor replacement of an asbestos LiCl dehumidifying rotor delivered to K. Electromagnetic Steel Plate Co. in 1980. The rotor mysteriously caught fire not at the inlet of the regenerative heating air, which has a heater and reaches the highest temperature, but from about 50 mm inside the inlet. However, I already knew why it was happening. The rotor I had prepared for replacement was a pre-fired rotor, and I knew it would burn in this manner during the development of the firing method. When heated air is introduced into the regeneration zone by an electric heater for regeneration, there are areas where the heater temperature is uneven, for example, about 180℃. Although 180° C is not the temperature at which asbestos paper ignites, it is the temperature at which it begins to oxidize. As the honeycomb gradually begins to oxidize, the temperature of the heated air passing through the honeycomb rises slightly. The temperature rises in a snowball fashion, with the temperature rising more and more as oxidation is accelerated further downstream, eventually igniting at the point inside the regenerated air inlet and spreading the fire downstream.

SSCR was developed from the accumulation of various development themes

- 1977 Joined Joint development 3 themes ×
  Ceramic heat exchanger development ×
- 1978 Centrifugal blower type total heat exchanger ×
- 1979 Exported heat exchanger technology to Korea ○
- 1980 Nonflammable dehumidifying rotor ○
- 1981 Deodorization and sterilization heat exchanger ×
- 1982 Honeycomb filter for Komatsu ○
- 1983 Japan's first desiccant air conditioner Okinawa
- 1984 Ceramic fiber catalyst carrier ×
- 1984 SSCR Development ◎
- 1987 SZCR Development (Hybrid of silica gel and zeolite) ○

Ideas can only come from the accumulation of knowledge

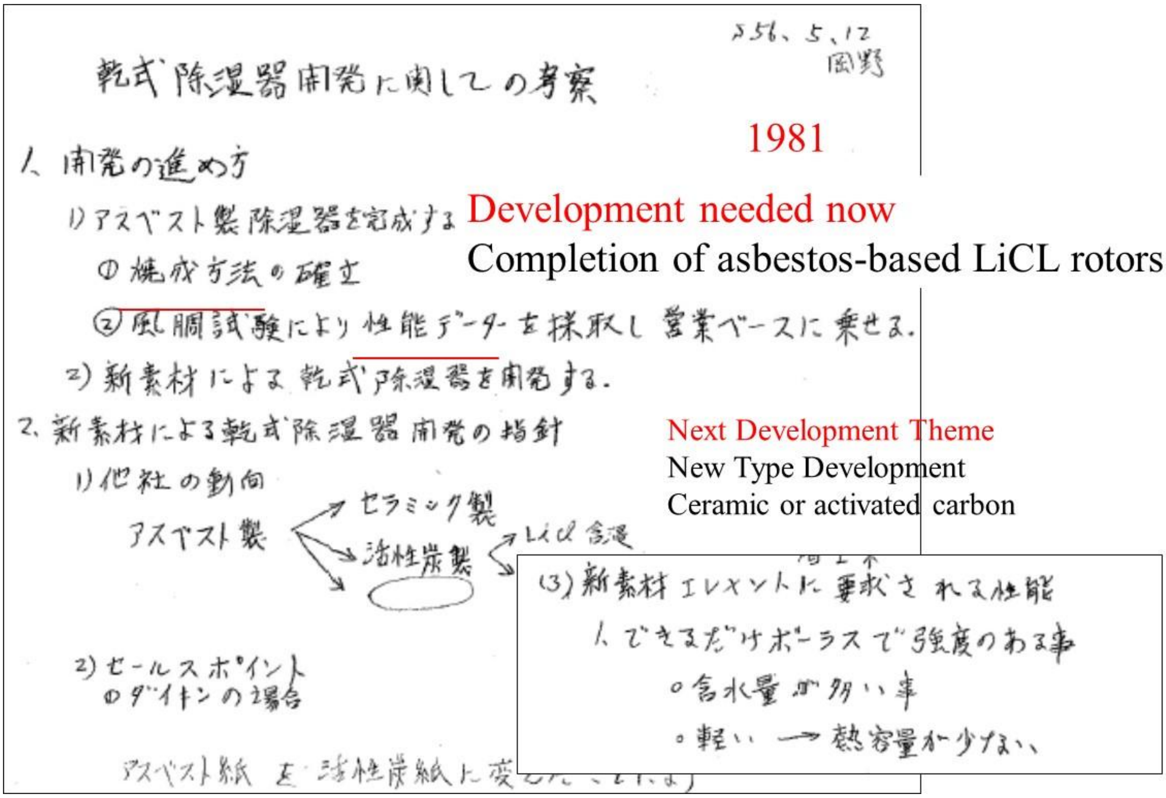
After joining Seibu Giken, I was given innovative development themes to work on every year. Many of these themes did not lead to commercialization because the management was on a tightrope and the innovative themes were also for obtaining public R&D funds. However, the knowledge and know-how gained from these R&D activities were accumulated and eventually led to the development of truly innovative rotors.

"Ideas can only come from the accumulation of knowledge!"

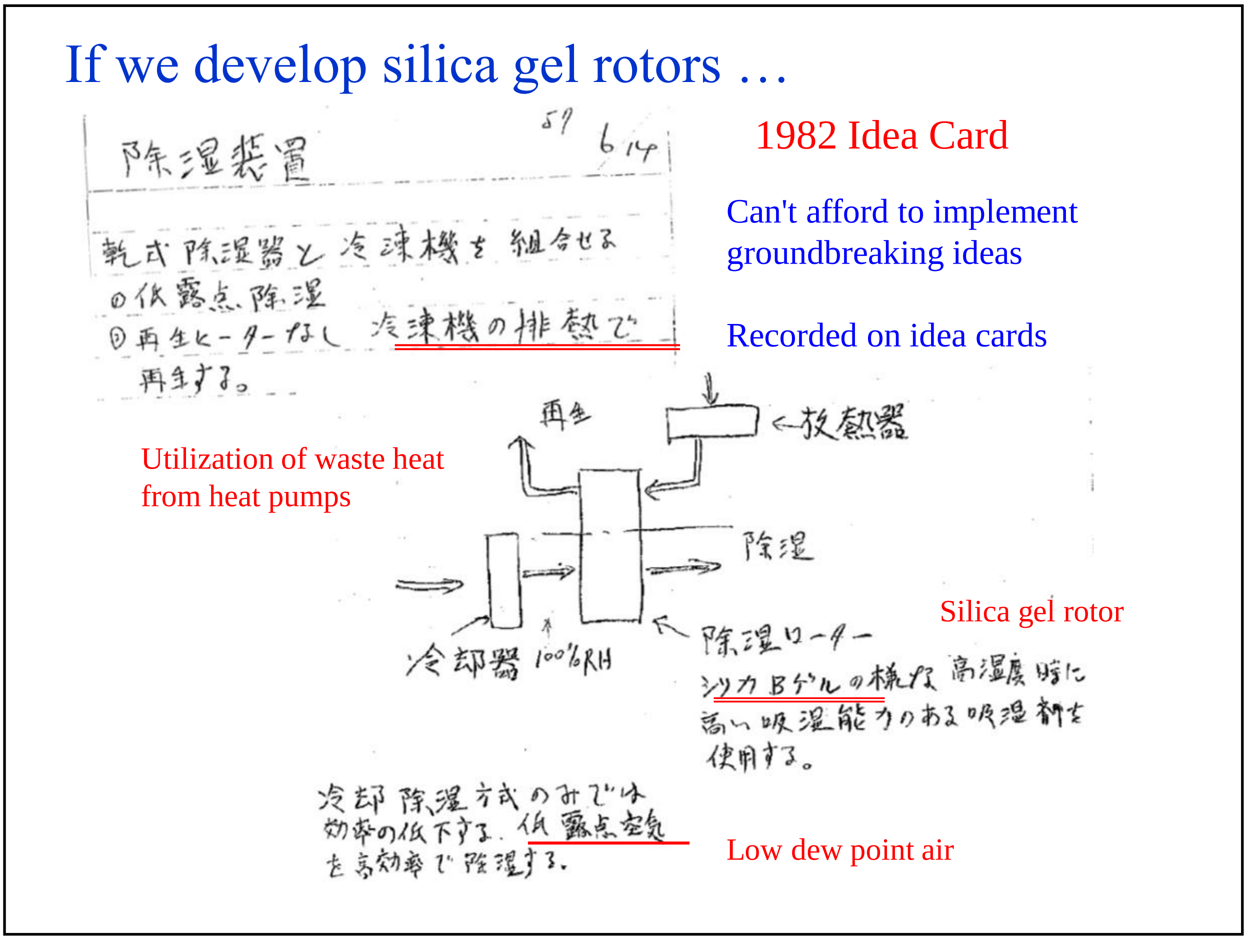
Words from President Kuma.

The more innovative the theme, the lower the probability of success, and the more stressful it may be that we may not succeed, or that some of us will stop before it becomes a huge failure. Only those who are willing to endure the pressure and take on the challenge will succeed. The problem is that because personally cannot stand the pressure, I end up doing repetitive tasks that produce reliable results, or commissioning work that ends when I tell them the results and my responsibility ends. One strategy for steadily advancing innovative themes is to have them work on a combination of innovative development themes and themes that are easy to produce results. Even if a theme does not turn out to be a "product" in the end, it is considered an achievement even if it proves that it cannot be done in that way. If such results are accumulated, they will eventually lead to a major accomplishment.

Proposal for Dehumidifying Rotor Development



I thought about how we should develop dehumidifying rotors. Even if the goal is to develop a rotor that can outperform other companies in the future, I thought that we must first complete a product that sells well and has no complaints. Once we have a product that sells well and is profitable, we will be financially stable, and then we will be able to take on the challenge of developing innovative products that will outperform our competitors. I prepared the above proposal and presented it to President Kuma. Thinking about it now, I think he wanted me to leave the matter to him a little more because I was thinking about it, rather than being instructed in various details.



New Ideas Emerge One after Another

In dry-type dehumidifiers using lithium chloride, which were the mainstream at that time, it was taboo to introduce the processed air with high relative humidity directly into the dehumidifying rotor after cooling and dehumidifying it in the first stage. This is because it would surely cause trouble or complaints. It must always be reheated by a preheater to a relative humidity of 75% or less before being introduced into the rotor. However, if we could develop an adsorption-type dehumidifying rotor that does not use lithium chloride, even if the performance of the rotor is a little poor, we could improve the dehumidification performance by directly introducing low-temperature, nearly 100% high relative humidity air after cooling and dehumidification in the first stage. Combined with the energy-saving performance of using exhaust heat from the heat pump, we thought we could develop a dehumidifier that could compete with the major manufacturers in the industry. However, at that time, Seibu Giken did not have the manpower, research and development funds, or time to make this happen. What we needed now was to develop a rotor that could be sold in the next month or six months. I tried to convince myself by writing down new ideas and thoughts on an idea card. I dreamed that one day I would be able to resurface and implement the idea.

Complaints and problems experienced with conventional LiCl dehumidifying rotors ～1982～

1. Corrosion of peripherals by leaked LiCl

At high humidity, excess moisture absorbed and liquid LiCl leaks out and corrodes peripheral equipment.

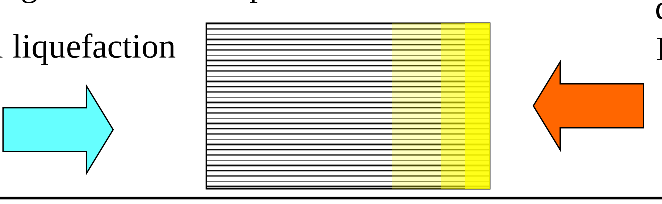
2. Dehumidifying performance degradation

LiCl moves to the regeneration air inlet side and concentrates => performance degradation

3. Fracture of rotor due to crystallization stress of LiCl

During moisture absorption

LiCl liquefaction



Capillary migration concentration on the dry side during regeneration + Recrystallization stress causes breakdown

We managed to develop a nonflammable rotor using the incense combustion firing method, and were finally at the stage of expanding sales, but next we were plagued by problems caused by the dehumidifying agent lithium chloride

.

The Devil's Work

One year after delivery, the calcined incombustible asbestos rotor that we delivered to Asahi Kasei Corporation Oita Plant in 1981 became as soft as paper clay, and the honeycomb was deformed so that air could not pass through it. The factory had a power plant. President Kuma and I investigated the cause of the damage by immersing the rotor in a strong acid solution and leaving it in boiling water for an extended period of time, but we were unable to determine the cause. We replaced the rotor with an unknown cause, but to our surprise, the same phenomenon occurred within a month. Was it the work of the devil? The lithium chloride liquid carryover due to insufficient regeneration air flow was also severe, so we replaced the regeneration blower with a powerful one, but again, without knowing the cause, we had no choice but to replace the rotor. No complaints occurred after this countermeasure, but the cause of this "devil's work" rotor collapse was not discovered until two more years later, in 1984.

Other companies ahead of us

乾式除湿機

初の活性炭

【大阪】ダイキン工業（本社大阪市）は、世界で初開発の活性炭紙に吸湿機能を付加し、従来の乾式より保水力が二倍で約二〇％の省エネ化と最大二分の一の省設備化を実現した産業用乾式除湿機「ハニードライ」を開発、このほど発売

Daikin

Activated carbon paper
honeycomb＋LiCl

ニューセラ 利用の熱交換器

ニチアスとバーナー社が開発

家庭用水耕栽培

セットを来月発売

Ceramic Paper
Honeycomb＋LiCl

Nichias
B･I

1983, DAIKIN was in hot pursuit of Munters, a long-established company, when it developed and released a new rotor with a honeycomb made of activated carbon paper impregnated with lithium chloride.　The use of porous, lightweight activated carbon with a large specific surface area as the carrier made it difficult for lithium chloride to carry over, and the high dehumidification performance was also a selling point of this new product.

In addition, the long-established Japanese company Burner International (Munters' Japanese distributor) has been working with NICHIAS to develop a ceramic fiber honeycomb rotor as a solution to the regulatory problem caused by the carcinogenic properties of asbestos.

How can we, as a small company, survive in the honeycomb dehumidifier market, where long-established and major manufacturers of dry-type dehumidifying rotors are entering the market in increasing numbers?　Looking back, it was a very daunting situation.

In fact, around 1978, we received an inquiry from DAIKIN about rotor processing on consignment, and when asked if we could really mass produce rotors, we showed them our rotor production facilities.

One day, DAIKIN sent us a corrugated piece of activated carbon paper and asked us to make a prototype of the winding and the rest.

Since they were able to do the corrugating process themselves, they wanted us to do the post-process of in order to lower the cost.

It was obvious that if they eventually became able to do everything themselves, they would pull out of Seibu Giken.

Furious, President Kuma said, "This is no good, send it back."　However, DAIKIN may have stolen our technology, and we subsequently became a formidable competitor in the fields of dehumidifiers and VOC concentrators.

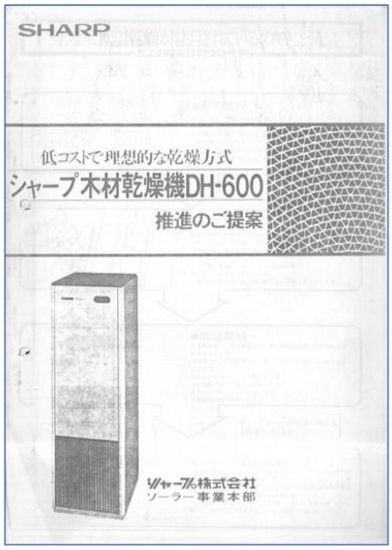
Entry of major companies

Asbestos honeycomb+LiCl

Toyo Seisakusho Co.

Mitsubishi Affiliated Companies

Non-woven paper honeycomb+LiCl



At the time, Toyo Seisakusho, a Mitsubishi affiliate, released a dehumidifier equipped with an asbestos-drying rotor developed by the company. In addition, Sharp Corporation, a major home appliance manufacturer, had released a dehumidifier equipped with a non-woven dry rotor for wood drying. Seibu Giken, which did not have the capacity to produce dehumidifiers themselves, believed that the only way to survive was to develop inexpensive, superior rotors that would be used by the major dehumidifier manufacturers.

Competition in the development of adsorption rotors

TOYOBO Activated carbon fiber
K- Filter Dehumidifier

Kobe Steel, Ltd.
Monolithic honeycomb silica gel

Competition in the development of adsorption-type honeycomb dehumidifying rotors was also beginning. Toyobo was in the process of developing a honeycomb-processed rotor made of paper with new active carbon fiber, whose pores were controlled to increase water vapor adsorption. However, it was a welcome development that a request for the staged processing of that paper and rotor production came to our company. This was because we were able to obtain information on the performance of the adsorption-type rotor.

Kobe Steel developed silica gel and zeolite honeycomb by extrusion method. They also began to develop and sell large rotors that solved the shortcomings of the extruded honeycomb method, which in principle could only be made in small sizes, by combining several methods.

Is it reckless for us to develop our own adsorption rotor that surpasses the newly developed rotors of other companies? How can our company, with only about 20 employees, compete with the new generation honeycomb rotors developed by a large company with basic materials development technology?

Competitors appearing one after another

- B･I (MUNTERS) Asbestos+LiCl 1967~
- Toyo Seisakusho Co. Asbestos+LiCl ~1975~
- DAIKIN Activated carbon paper +LiCl 1981~
- SHARP Non-woven paper honeycomb+LiCl 1982
- NICHIAS+B.I Ceramic +LiCl 1982~
- TOYOBO Activated carbon fiber ~1982~
- SEIBU GIKEN **SSCR** Silica gel honeycomb 1984~
- KOBE STEEL Monolithic honeycomb 1985~
- TOHO GAS Co. (Nichias?) Zeolite honeycomb 1985

Our competitors are still large, well-known companies. We have only honeycomb processing and rotor technology for total heat exchangers. In order to survive, we have to either accept outsourcing from these competitors or develop a high performance rotor at a cost that they will buy it.

Think about it once.

"If you had been a party to this situation at the time, instead of me, what would you have thought and done?."

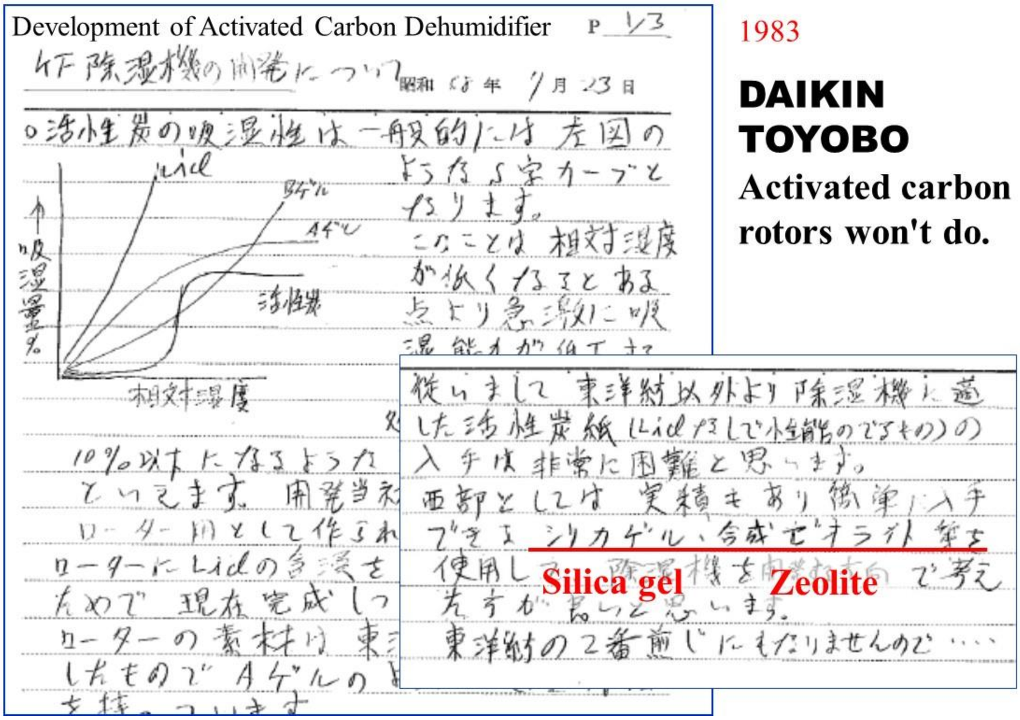
"What could you have done?."

While conducting joint research with leading large companies such as Nittetsu Mining, Toyobo, Taikisha, Sanyo Electric, Catalytic Chemical Industry, Sakai Chemical, etc., and learning about the excellent researchers and research facilities of the other companies, as a R&D manager of our company of only about 20 people including part-time, I wondered what I could do to help the company to survive. What could I, a graduate of a second-rate private university, do to help the company survive? Do I stand a chance? But I felt that my dexterity and original ideas were unbeatable. Frankly, I thought that if I tried to think and do the same things they did, there was no way I could win.

"We would have to compete on the basis of our original wisdom."

If I could think and develop two or three steps ahead of what the top companies and their researchers were trying to do, then maybe I could win. I was not pessimistic because it might not be possible to win, but it would be interesting and rewarding for me to compete in the battle of originality and wisdom.

Oppose policy of developing dehumidifying rotors made of activated carbon


Development of Activated Carbon Dehumidifier P 1/3

AF除湿機の開発について 昭和58年7月23日

○活性炭の吸湿性は一般的には左図のようなS字カーブとなります。このことは相対湿度が低くなるとある点より急激に吸湿能力が低下する

LiCl

Bゲル

Aゲル

活性炭

吸湿量%

相対湿度

10%以下になるような

といてます。開発当初

ローター用として作られ

ローターにLiClの含浸を

ためで現在完成しつ

ローターの素材は東

したものでAゲルの

を持っています

従いまして東洋紡以外より除湿機に適した活性炭紙(LiClなしで性能のでるもの)の入手は非常に困難と思います。

西部としては実績もあり簡単に入手できるシリカゲル、合成ゼオライト等を使用し除湿機を[illegible]で考えた方が良いと思います。

東洋紡の2番煎じにもなりませんので・・・

Silica gel

Zeolite

1983

DAIKIN
TOYOBO
Activated carbon rotors won't do.

One day, President Kuma and other technical executives gathered to discuss the future development of dehumidifying rotors. We must develop a new dehumidifying rotor that is competitive and does not use asbestos, which is banned because of its carcinogenic properties. DAIKIN was expanding its market with a rotor made of activated carbon paper honeycomb impregnated with lithium chloride. TOYOBO had also developed a revolutionary adsorption-type dehumidifying rotor using activated carbon fiber paper for dehumidification developed in-house, which does not use lithium chloride, and sales were expanding, so dehumidifying rotors made of activated carbon will be the mainstream from now on. We concluded that we should develop an activated carbon dehumidifying rotor. I disagreed, but a young man's unsupported opinion is not persuasive. I was not convinced by any means, so I later wrote up the above opinion and submitted it to President Kuma.

Development of Ceramic Catalyst Support
Subsidy project by MITI

中小企業技術改善成果普及講習会

セラミック繊維ペーパーをマトリックスとするNOx
分解用触媒担体の新製法に関する開発研究

㈱西部技研

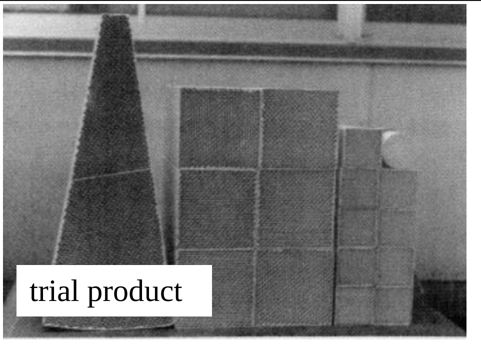
1984. 4 ～ 1985. 3

期日　昭和61年3月20日
場所　福岡商工会議所

主催　中小企業庁
　　　福岡通商産業局
　　　福岡県

- ■**Ceramic paper development**
- ■**Development of ceramic honeycomb manufacturing method**
- ■**Development of eramic firing method**

Basic technology for ceramic honeycomb production

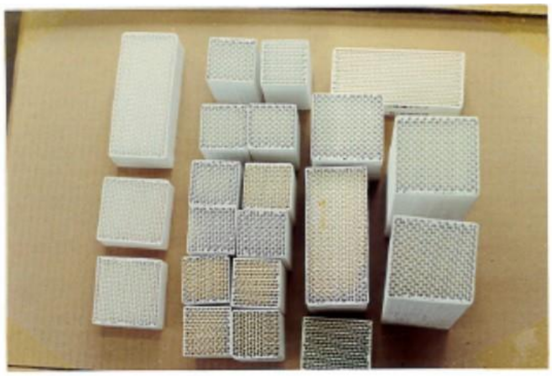

trial product

Around 1983, air pollution caused by NOx from power plant exhaust gases became a problem, and companies began to develop De-NOx catalyst honeycomb. We received inquiries from two companies, Catalyst & Chemicals Industries and Sakai Chemical Industries, and we were working on prototypes. Based on these market trends, President Kuma succeeded in obtaining development funds from MITI for the development of ceramic catalyst carriers. While making prototypes of catalyst carriers for Sakai Chemical Industries Co. and Catalytic Chemicals Co., he developed a firing method, reviewed the honeycomb shape to improve honeycomb strength, selected a binder, added a firing strength strengthening agent, and also made prototypes of new production equipment such as a simultaneous molding and cutting impregnation machine for mass production. This theme was ultimately defeated in a development competition with a large company, NICHIAS, and did not see the light of day as a product. However, through this R&D project, we were able to develop the technology to produce ceramic honeycomb, which will lead to the next new product.

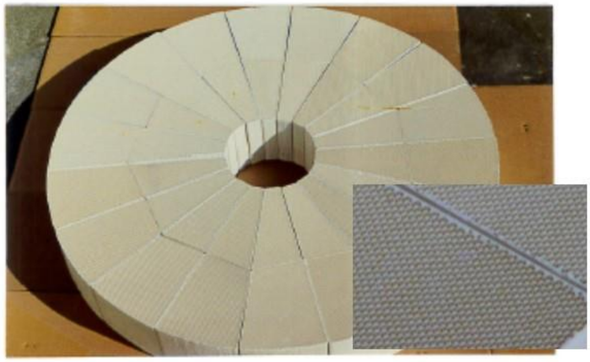
Successful firing technology in Prototype 3

1984 Prototype 3

Prototype 3 firing furnace
reproduced in 2015



Prototype catalyst support



Ceramic sensible heat exchange rotor

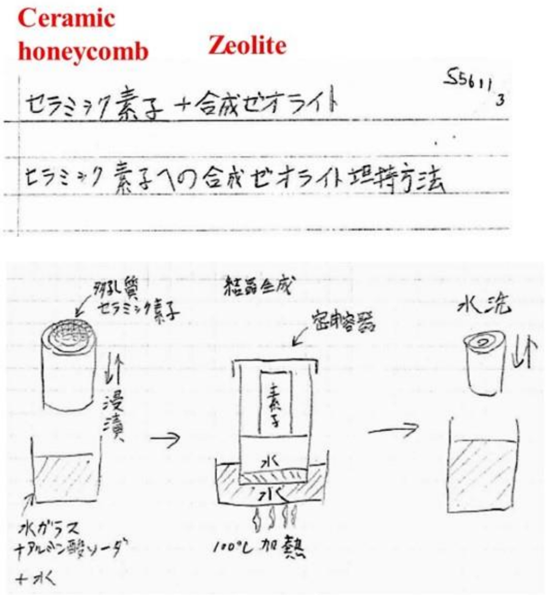
With the development of "Ceramic Fiber De-NOx Catalyst" in 1984, we are trying again to develop "sintering technology that can be mass-produced. This is one of the most important themes because large quantities of catalyst carriers for power plants, for which mass orders are a prerequisite, must be sintered in large quantities. President Kuma considered outsourcing and contacted a heat treatment manufacturer. The heat treatment manufacturer had a large furnace, which was sufficient to raise the firing temperature. The heat treatment manufacturer took the test block home, saying, "No problem." However, the next morning, he left the block pieces, which had burned to ashes, and fled.

"What to do now?."

One day, I suddenly came up with a solution. Within a week of coming up with the idea, we produced prototype No. 3 as shown in the photo above left. The reason we were able to do it in such a short time was because we made it ourselves instead of outsourcing. I did not need to wait for outsourcing because I could do the welding and lathe work by myself, although I had to ask a steel shop for stainless steel cut sheets. I used parts and materials that were available in the company and purchased quartz glass tubes from a glass shop near Kyushu University.

After the third prototype, I was finally able to perform short-time firing, so I used the prototype firing furnace for the catalyst carrier prototypes, while having the production engineering department design and manufacture a large firing furnace and dryer for mass production.

The idea of synthesizing adsorbent directly into honeycomb



1981 Idea card

1984 Idea card

The idea of synthesizing adsorbent in the matrix of honeycomb

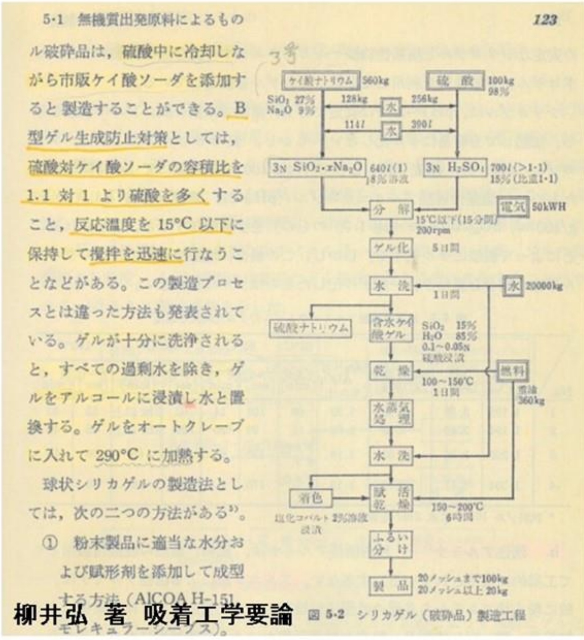
With the cooperation of a paper manufacturing company, we once developed a dehumidifying honeycomb made of ceramic paper containing zeolite, but the honeycomb did not absorb enough moisture to meet the target amount of zeolite. It was thought that the zeolite may have escaped through leakage or decomposition. We also found that the ceramic paper containing silica gel deteriorated thermally during subsequent firing, so we stopped using it.

Based on these experiences, we wondered if it would be possible to synthesize and fix the adsorbent in the honeycomb matrix, and this is the idea card mentioned above. In addition to this, we also tried to make a trial product of carbonizing honeycomb by impregnating it with resin to make activated carbon honeycomb. However, at that time, the technology and equipment to evaluate the performance of activated carbon had not been established, so it was just a play of shape prototyping. However, such "fun" led to the invention of the innovative dehumidifying rotor SSCR.

Silica gel synthesis literature obtained

1984.03.10

Conventional sol-gel method



5·1 無機質出発原料によるもの　123

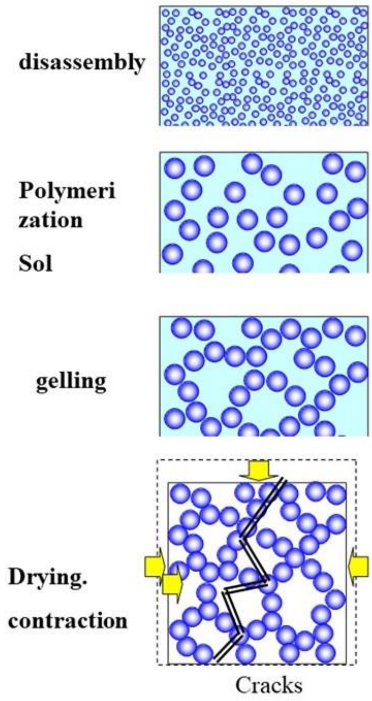
ル破砕品は，硫酸中に冷却しながら市販ケイ酸ソーダを添加すると製造することができる。B型ゲル生成防止対策としては，硫酸対ケイ酸ソーダの容積比を1.1 対 1 より硫酸を多くすること，反応温度を 15°C 以下に保持して攪拌を迅速に行なうことなどがある。この製造プロセスとは違った方法も発表されている。ゲルが十分に洗浄されると，すべての過剰水を除き，ゲルをアルコールに浸漬し水と置換する。ゲルをオートクレーブに入れて 290°C に加熱する。

球状シリカゲルの製造法としては，次の二つの方法がある[3]。

① 粉末製品に適当な水分および賦形剤を添加して成型する方法（AlCOA H-151 モレキュラーシーブス）。

図 5·2 シリカゲル（破砕品）製造工程

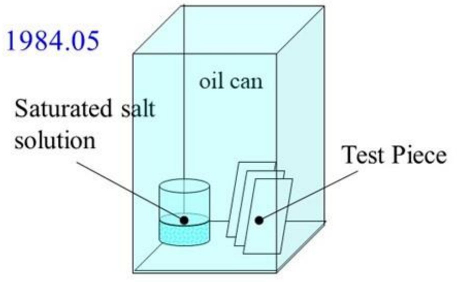
柳井弘 著 吸着工学要論



The Trigger for the Invention of the Silica Gel Rotor Synthesis Method

In those days, whenever my family and I went shopping, we always went to a bookstore and enjoyed stopping by the technical book section to look for technical books that caught our interest. In March 1984, I found a book titled "Adsorption Engineering. The book described the specific synthesis process of silica gel and other materials I was looking for, and I went home happy as if I had found a treasure. I immediately tried mixing dilute sulfuric acid with water-glass solution as described in the book, but as soon as the dilute sulfuric acid was added, a lump formed, and the silica gel I had imagined was not produced. After thinking for a while and mixing it well, a clear and smooth sol solution was formed. As time passes, the viscosity gradually increases and it becomes a transparent hard agar-like gel. After rinsing and drying, the gel shrinks to about 1/8th of its original volume and cracks, forming a crumbly, glass-like silica gel. I thought, "This is it!" I tried impregnating ceramic paper with the freshly mixed, sol solution, but as it dried, the silica gel shrank and broke on the inside and surface of the paper, cracking it into pieces and causing it to become sand-like and fall off in a rough and coarse manner.

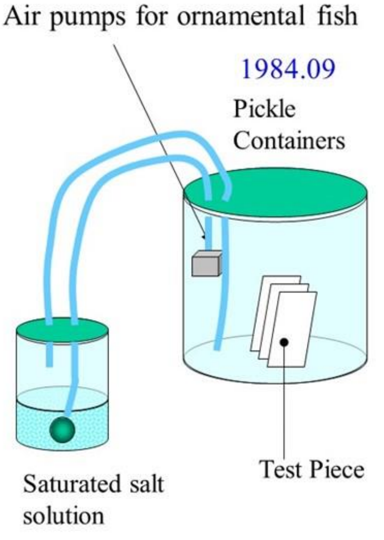
Resolving Research Funding and Equipment Shortages with Wisdom



First equilibrium adsorption evaluation device

Oil can

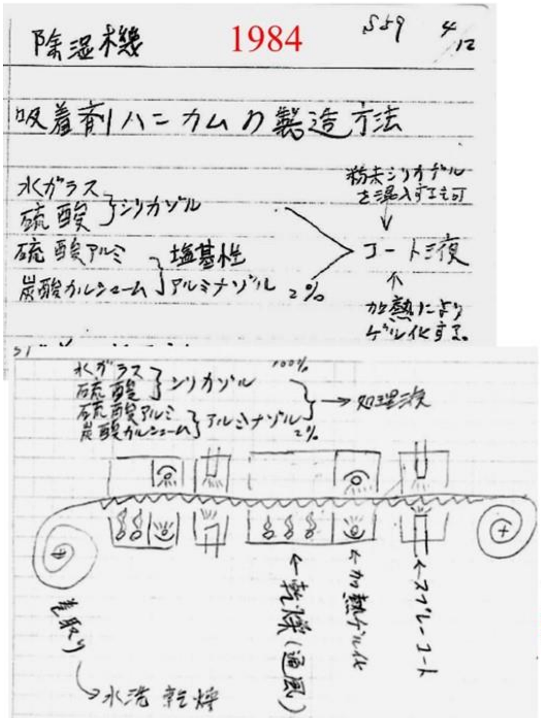
Test piece tested on a prototype



Material cost less than $10

While experimenting with various silica gel synthesis treatment methods, we also considered methods for evaluating the prototype. Taking a hint from the saturated salt method of humidity sensor verification, we placed a beaker containing saturated salt and the prototype in an oil can, covered it with a lid, and measured the amount of moisture absorption by measuring the weight gain after one day. The saturated salt method was used for sodium chloride at 75% RH, magnesium chloride at 35% R H for magnesium chloride, and 15%RH for lithium chloride, and the adsorption isotherms were measured one after another over a week or so. The measurement speed is further improved and the data is more stable. In order to further improve the measurement speed and stabilize the data, an equilibrium moisture adsorption test apparatus like the one shown in the figure above right was manufactured, which enabled us to conduct the experiment smoothly. We were short of equipment, people, and funds. I am proud of the fact that we were able to achieve our goal with a budget that was about the size of an allowance through our ingenuity. We also considered a less time-consuming method for sample prototyping and testing. The specimens were made by processing ceramic paper cut into 100 mm squares, and after evaluation, they were simply placed in a bag and filed.

Serendipitous invention through repeated trial and error



■When the sol dries, it becomes coarse sand-like **Failure** March

■ Spherical silica gel manufacturing method was used as a reference.

Failure April

But it is the catalyst for breakthroughs.

■Honeycomb impregnated with water glass and immersed in sulfuric acid

⇒flowed out Failure May 8

■**Dried impregnated with water glass and immersed in sulfuric acid**

⇒A little better, but... ?? May 19

■Treated with chemicals that trigger breakthroughs to try it out.

⇒Weak strength Failure

■Measuring with the thought of futility

Surprisingly high performance

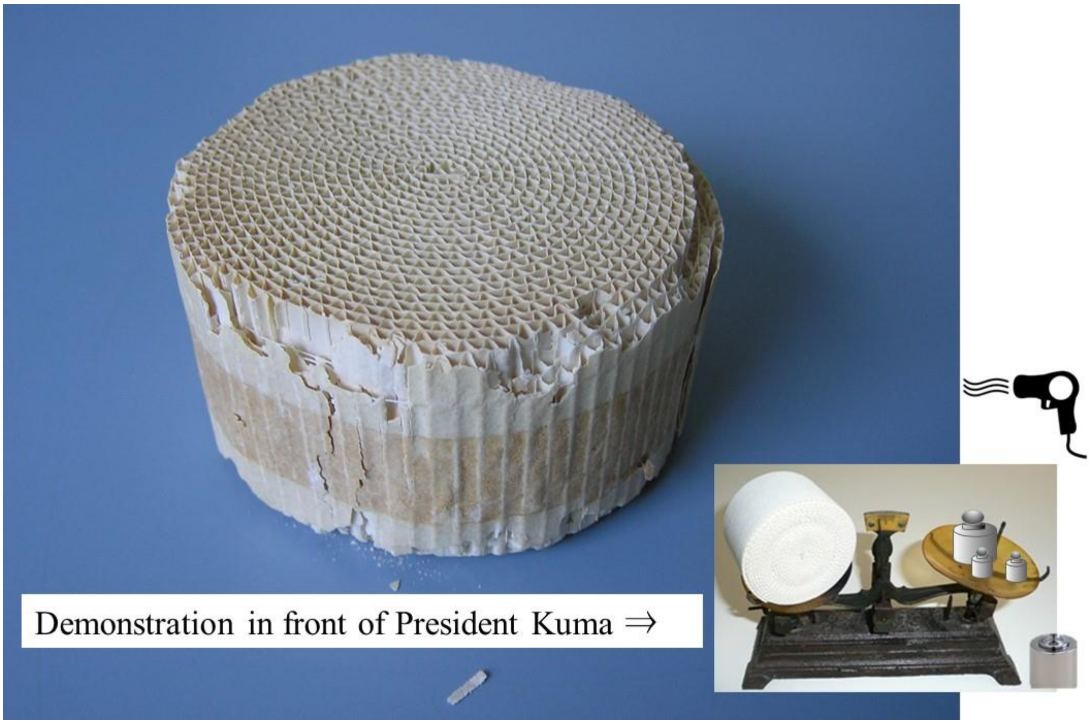
Success September 29.

Silica gel honeycomb synthesis was truly a Serendipity invention. Since the first method did not work, I also focused on the spherical silica gel production method in a technical book and experimented with the recipe, but it was still a failure. However, the chemicals I purchased at that time led to a breakthrough later.

At that time, we devised a method of impregnating paper with water-glass solution first and then immersing it in dilute sulfuric acid for a reaction. Then, what would happen if the paper is impregnated with water-glass solution, dried and concentrated, and then immersed in dilute sulfuric acid? Strength and moisture absorption improved a little. But, "It is dangerous to use a large amount of dilute sulfuric acid at the production site, and the site may not want to use it. What should we do?" I was experimenting with the idea. Even if we could develop a good product, it would be difficult to commercialize it if there were large capital investments or safety issues. We proceeded with an awareness of how we could use the current production line as much as possible. One day, out of intellectual curiosity, I tried immersing the total heat exchanger rotor in a different chemical solution that I had obtained in the previous experiment instead of calcium chloride solution, because the manufacturing process for total heat exchanger rotors involves impregnating water glass and then neutralizing it by immersion in a calcium chloride solution. The strength was weak, and it seemed that we would end up playing around again. However, when we measured the amount of moisture absorption as a trial, we were surprised to find that it was more than twice the moisture absorption performance of the previous test.

The trial-and-error process started with the textbook silica gel manufacturing method, but as we did various curious "useless things," we got a little better at it and gradually approached a manufacturing method that could be produced at a factory. After repeating and failing at "useless things" that would fail, we finally came up with the invention of Serendipity!

1984 Honeycomb rotor prototype No. 1



I made a prototype of the rotor shown in the photo, about 60 mm in diameter, by hand. I went to the president's office to report the results with a dirty upper-dish balance and a hair dryer. If you blow cold air on the prototype rotor, the rotor becomes heavier, and if you blow hot air on it, it becomes lighter in no time. many times. President Kuma could hardly believe it. “Not only because I am an amateur chemist, but also because the manufacturing process we ended up with was similar to the process for total heat exchanger rotors. If it could be done in such a simple way, Munters would have invented it first. There must be some crucial flaw.”

From that day on, I was devoted to proving that this new honeycomb was indeed a wonderful, foolproof product, and to researching the process and manufacturing conditions.

Looking back, when I was experimenting with reacting with dilute sulfuric acid, I was worried that the factory floor would resent me for being "dangerous. In the end, the reaction solution was the same as the chemicals used to purify water at water purification plants and sewage treatment plants, and the reaction product, sodium sulfate, is the main ingredient of bath salts, so draining the flushing solution did not cause any pollution. I was relieved.

One morning when it began to get cold, crystal-like crystals formed in the prototype rotor processing solution, which reminded me of the crystals I had seen as a boy. When cooled, the reaction product, sodium sulfate, crystallized and could be separated. I had found a way to recycle the processing fluid. Finally, we came up with a manufacturing method that would allow us to mass-produce the product without using hazardous chemicals and to recycle the processing fluid, which is what we had hoped for.

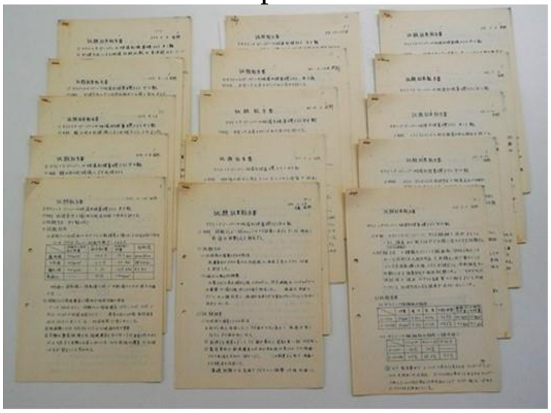
The product name of the new rotor, SSCR, is derived from the first letters of the alphabet: Seibu-Giken, Silica gel, Ceramic, and Rotor.

SSCR synthesis know-how established

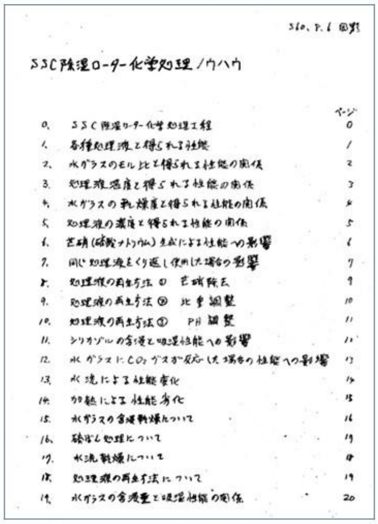
Test report

SSCR 15 Report 1984.5~1986.5

SZCR 2 Report 1987.1~1987.7



Know-how collection



S60. 7. 6

SSC除湿ローター化学処理ノウハウ

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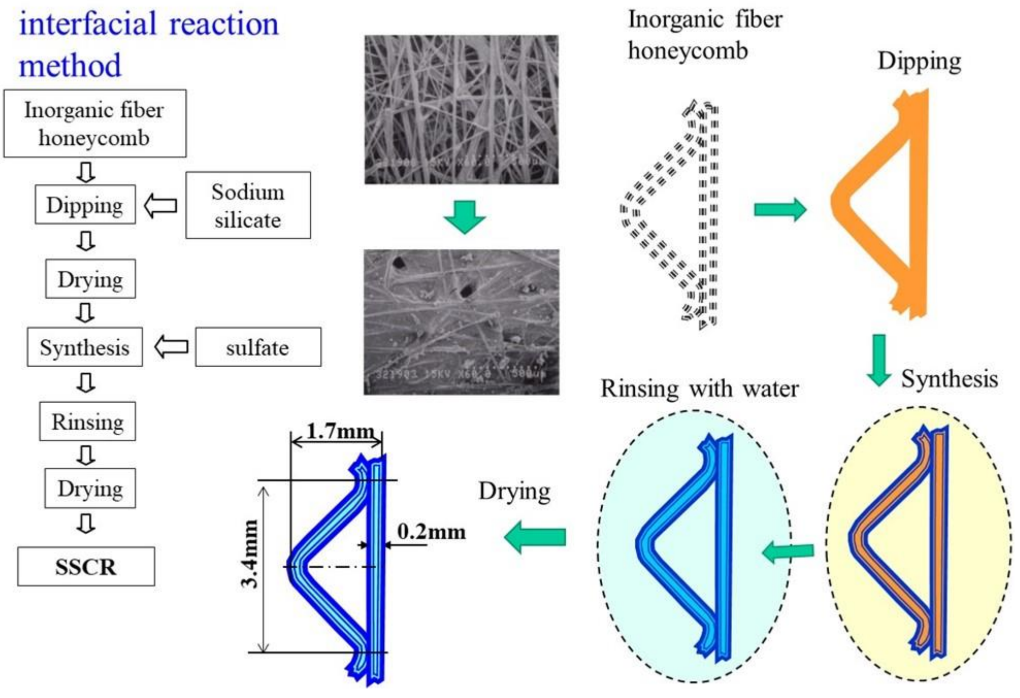
The photo above is a report of the SSCR synthesis method research. The first two reports are research reports on the reaction with dilute sulfuric acid, but from the third report, the breakthrough is the research report on the reaction method with sulfate. We also studied other salts such as nitrate, hydrochloride, phosphate, different metal ions, and the effects of different types of water glass. To establish the synthesis method, we conducted various tests and accumulated data on reaction conditions, concentration and temperature of the treatment solution, effects of purity, etc., and compiled them into the "SSCR Dehumidifying Rotor Synthesis Know-How Document" as shown in the above figure on the right. We aimed to transfer production.

However, the silica gel honeycomb, which was being synthesized in a large product size, changed dimensions like a living creature in the processing solution, peeling off and deforming, making it difficult to successfully produce the product. However, thanks to the efforts of those on the production floor, productivity gradually improved. Under the direction of President Kuma, the Production Engineering Group worked to increase the speed of molding, improve manufacturing equipment, and automate production. Also, we must not forget that the processing and assembly technology for large rotors was dramatically improved through the application of wood processing technology by engineers who had joined the company from a wood processing company that had gone bankrupt. Thanks to the wisdom and efforts of many people, SSCR has become a product that can be sold around the world.

Innovative silica gel synthesis method

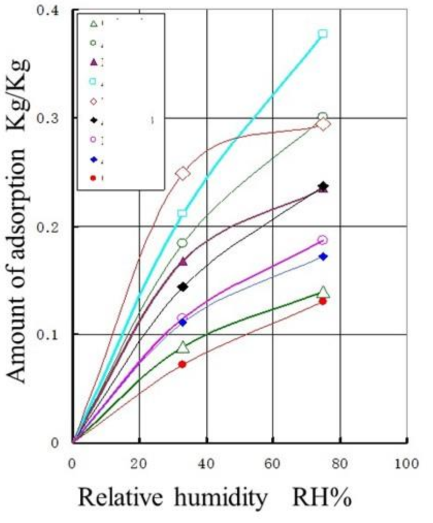


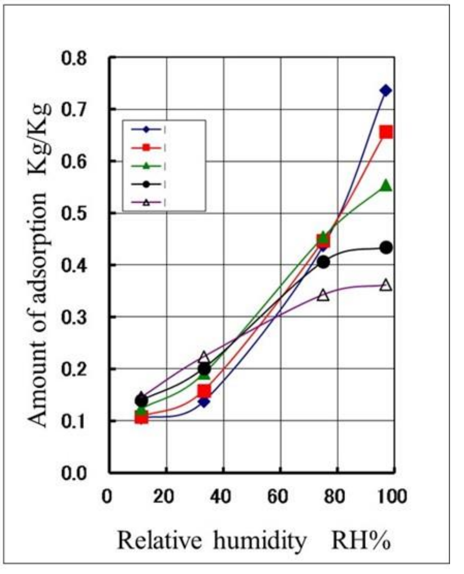
SSCR is strong because it is made of silica gel tightly integrated with fiber groups in a matrix of ceramic paper honeycomb. Ordinary silica gel is easily cracked, and cracks instantly when it comes into contact with water in a dry state.

The silica gel synthesis method invented by me, an amateur chemist, may seem "incomprehensible" to experts, but I thought there was nothing better than to make it useful in practical use. Recently, however, I found an appropriate term for this innovative silica gel synthesis method. It is the "interfacial reaction method. In the conventional "sol-gel method," a sol solution mixed with water glass and dilute sulfuric acid is gradually polymerized into a gel to form silica gel. In the "interface reaction method," water glass is impregnated and dried on honeycomb, which is then immersed in a sulfate solution, and the reaction progresses gradually from the interface to the interior of the water glass. The water glass that has been concentrated and solidified during the reaction absorbs water and either swells or conversely shrinks due to the difference in osmotic pressure between the water glass and the sulfate, and the honeycomb reacts as if it were alive and turns into silica gel.

Honeycomb silica gel synthesis method optimization

Test report No.1（1984.5）~**No.15**(1986.5)





The synthesis of silica gel by the "interfacial reaction method" adds a different factor from the "sol-gel method" that had been used until then, and is a very interesting research theme for chemists. The first process patent was filed by President Kuma to expand sales of SSCR as a wonderful product protected by our unique patent. It was necessary for a small company of 20 to 30 people in the countryside of Kyushu to disseminate and expand sales of our own developed products to the "world".

Later, in 1997, when I returned to the development department from the manufacturing department, research and development on desiccant air conditioning became a trend at industry conferences.

The "ideal desiccant rotor characteristics" began to be discussed at conference presentations and research meetings. Various newly developed desiccant materials such as various types of low-temperature regenerated zeolite ETS, USY, and polymer sorbents were developed and announced one after another worldwide. I will challenge the competition to secure superiority in terms of both rotors and equipment to further improve the performance of SSCR. In the process, the ideal adsorption characteristic theory "absolute humidity-relative humidity rate of change method" focusing on temperature and humidity changes during dehumidification operations on an Psychrometric chart was gradually established over a period of more than 20 years.

1985 President's Award for SSCR

No lithium chloride

Eliminates shortcomings of conventional products

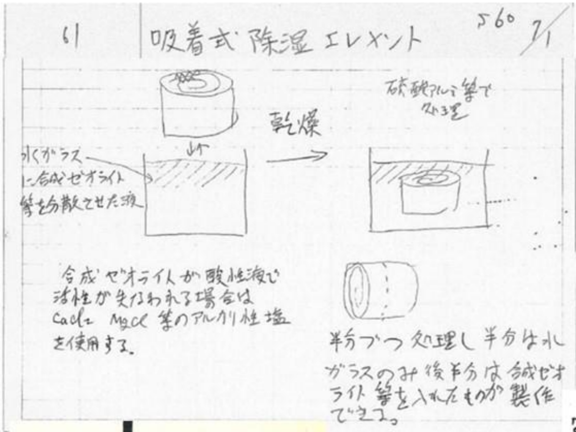
Looking back on the invention and development of SSCR, the year of its invention, 1984, coincides perfectly with the period when we started "Development and research on a new manufacturing method of catalyst carrier for NOx decomposition using ceramic fiber paper matrix" subsidized by MITI.

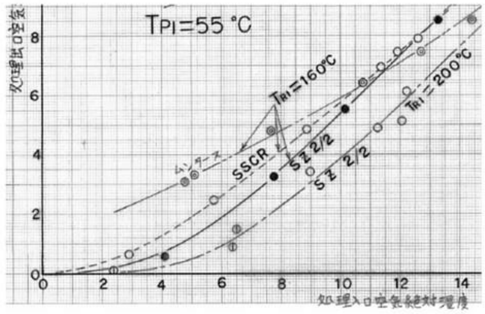
While we were in the midst of implementing an important R&D theme for which we had even received a grant, President Kuma gave us permission to try an outrageous idea, in which a chemical amateur in the mechanical shop would chemically synthesize silica gel in a honeycomb rotor of adsorption type, "as long as it does not interfere with the important theme. This led to the invention of SSCR. During the year of 1984, we developed ceramic honeycomb, the base material of SSCR, and its sintering method. I am now looking back and amazed at the miraculous year that I was able to establish the ceramic honeycomb that would become the base material of SSCR, its firing method, and even the synthesis method of honeycomb-shaped silica gel in 1984. Without fear of misinterpretation, the entire 20 years since I joined the company and the 20 years that followed with President Kuma seem to have been a miracle.

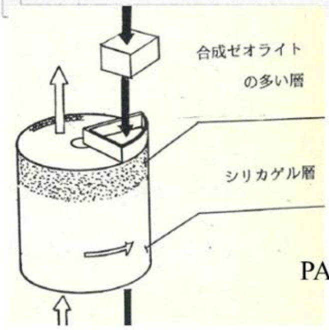
Let me tell you why we were able to do this single-handedly. It is because we devised a method of prototype testing that does not require a lot of time and effort. Once we came up with the idea, sample preparation was a process of impregnation, drying, rinsing, and drying, which took only a few minutes to a few dozen minutes each time it was needed. It took some time to prepare the report, but it was not hard at all to work overtime to sell my results to President Kuma (to get him to hire me).

Hybrid idea of silica + zeolite SZCR

1985







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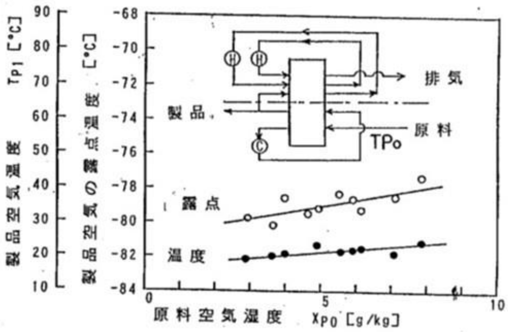


Silica gel + Zeolite hybrid rotor SZCR

We took on the challenge of developing a rotor with even higher performance. The SSCR has superior low dew point dehumidification performance compared to conventional lithium chloride impregnated dry dehumidifying rotors, but we considered hybridizing it with zeolite, which has even better low dew point performance. Based on the knowledge accumulated through the basic development of the SSCR, we developed a hybrid rotor of silica gel and zeolite SZCR was developed based on the knowledge accumulated through the basic development of SSCR. Furthermore, we developed a patented flow that can achieve a dew point temperature of -80° C with a single rotor. However, this new unit was never released to the public, perhaps because it was too advanced or was not needed at the time.

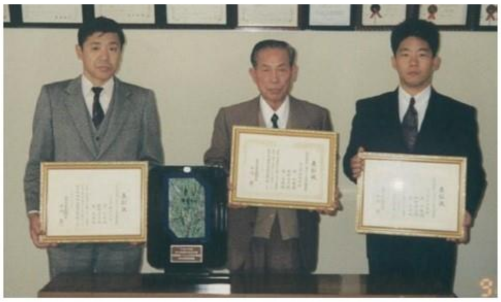
Since the SZCR is capable of high-temperature regeneration and high-temperature air dehumidification, it was gradually sold for use in drying PET resin pellets.

However, the SZCR still had problems with stable manufacturing and cracking. A few years later, however, a younger member of the development department developed the current SZCR, which can be easily mass-produced. This technology was also developed into the VOC-recovery zeolite rotor UZCR.

Received Daily Industrial News "10 Greatest New Products Award" in 1987 SZCR

Ultra-low dew point dehumidification rotor

A complete change in dehumidification common sense



←1992 Technical Award of the Adsorption Society of Japan

In 1987, we received the industrial newspaper “Ten Best New Products Award.” The award was given for the development of the SZCR. I believe that Seibu Giken's technology was recognized as genuine through the development and commercialization of the SSCR and the increase in sales, and that the development of a high-performance low dew-point dehumidifying rotor also earned us this award. Furthermore, in 1992, we received the Technology Award from the Adsorption Society of Japan.

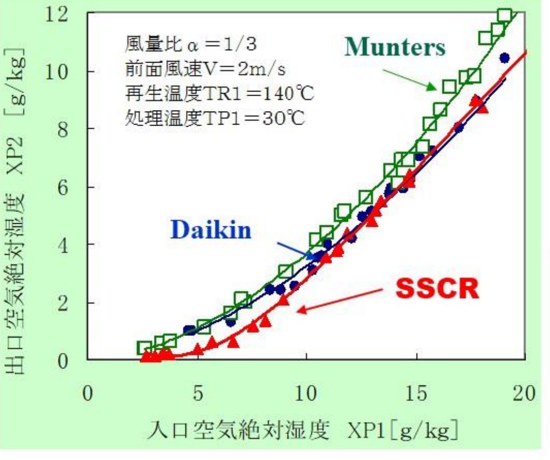
SZCR: Hybrid rotor of silica gel and zeolite.

Zeolite has stronger dehumidifying power than silica gel, but has the disadvantage of requiring high-temperature energy for regeneration. Therefore, zeolite and silica gel are integrated into a single rotor to take advantage of their respective characteristics and enhance the low-humidity side performance

Ten Best New Products Award

Comparison with other companies' rotors

	Munters	Daikin	SSCR
ロータ仕様	乾式A	乾式B	吸着式
ハニカム基材	ガラス繊維紙	活性炭紙	セラミック繊維紙
ハニカムピッチ[mm]	3.34	3.57	3.4
ハニカム高さ[mm]	2.3	1.93	1.8
セル数[cm-2]	26.0	29.0	32.7
吸着剤の種類	珪酸塩＋LiCl	活性炭＋LiCl	メタルシリケート
吸湿剤担持方法	含浸担持	含浸担持	化学合成担持
嵩比重[kg/m^3]	164.5	185.1	207.8



In every aspect Surpassing conventional products

testing apparatus

Especially advantageous is its high performance in the low dew point range, which is difficult to achieve with cooled dehumidification.

We have analyzed and evaluated the performance of dehumidifying rotors made by Munters and Daikin, the top two companies in the dry dehumidifier market at the time. The SSCR rotor has particularly good dehumidification performance at low humidity (low dew point temperature), and although we were not aware of it at the time, it will become an overwhelming advantage in the rapidly expanding low dew point dehumidification market, such as dry rooms in lithium battery factories.

For the performance test, we built a prototype of the compact, compact, and easy-to-control test apparatus shown in the photo above right, instead of the traditional installed wind tunnel test apparatus. The size of the test apparatus was set as standard, with a maximum diameter of Φ320 , which could be fired in a prototype firing furnace. This size is still the standard for performance test equipment. The regenerative heater is a handmade heater made by coiling in-house nichrome wire and hardening it with ceramic. The face seal was made by combining Teflon glass cloth and foamed silicon rubber sheet. This is the prototype of the current face seal.

This was a time when equipment, people, and funds were in short supply. Even without the equipment to create air conditions for performance testing, we were able to measure, accumulate, and edit dehumidification performance based on temperature and humidity changes in outside air over the course of a year, and thus proceed with performance testing without any particular manpower or cost. Furthermore, this test equipment was also used for durability performance tests over time, including unmanned, 24-hour continuous operation with a safety feature.

What was SSCR revolutionary for users?

1. Outstanding durability compared to LiCl rotors
   Re-impregnation with LiCl at the manufacturer after 2 years: LiCl is unevenly distributed and performance deteriorates.
   Lifetime in 4 years: Crystal of LiCl ⇔ deterioration of rotor strength by tidal action.

2. No problem even at 100% RH
   LiCl rotor needs pre-heater after pre-cooler
   SSCR does not require pre-heater => energy saving, performance improvement, cost reduction

3. No need for moisture-proofing when operation is stopped
   When LiCl rotor is stopped, inlet/outlet blockage is required
   The device was difficult to use and complained about a lot.

4. Washable when soiled

★The world's attention

The basis of product competitiveness is Q: quality, C: cost, and D: delivery time, but the SSCR was a revolutionary competitive dehumidifying rotor that did not depend on any of these. Compared to other dehumidification methods such as cooling, adsorption tower, and wet dehumidifiers, dry dehumidifiers, which were the mainstream at the time, had the advantages of being compact, portable, low power consumption, easy low dew-point dehumidification, and easy handling, and the market was expanding. However, once the SSCR was introduced to the market, it became an imperfect device with many shortcomings as shown above. The SSCR solved all the shortcomings of conventional dry dehumidifying rotors.

When President Kuma visited Munters later that day, he was told by the other party, "We invented and commercialized the honeycomb rotor dehumidifier, but it was Seibu Giken that perfected it."

At an exhibition, DST exhibited a small SSCR rotor submerged in a tank with goldfish swimming in it. The goldfish were not harmed at all and the SSCR rotor did not impair its function, so it attracted a lot of attention.

One day, an employee with experience selling Munters dehumidifiers washed and serviced an SSCR dehumidifier that had been covered in muddy water due to flooding, and started it up. He was impressed to see that the dehumidifier began to dehumidify rapidly while spewing water spray and white steam from the regenerated air outlet. "The dehumidifier was so tough and amazing that it was unthinkable for a conventional dry-type dehumidifier."

Business meetings Europe August 1987 (Germany, Sweden)

DST => Seibu Giken DST AB in 1993

This photo was taken at dinner during a visit to DST in Sweden following a visit to KAH in West Germany. President Ankarstig and Vice President Jonson of DST are next to Mr. Erik from SVENSKA DAIKIN.

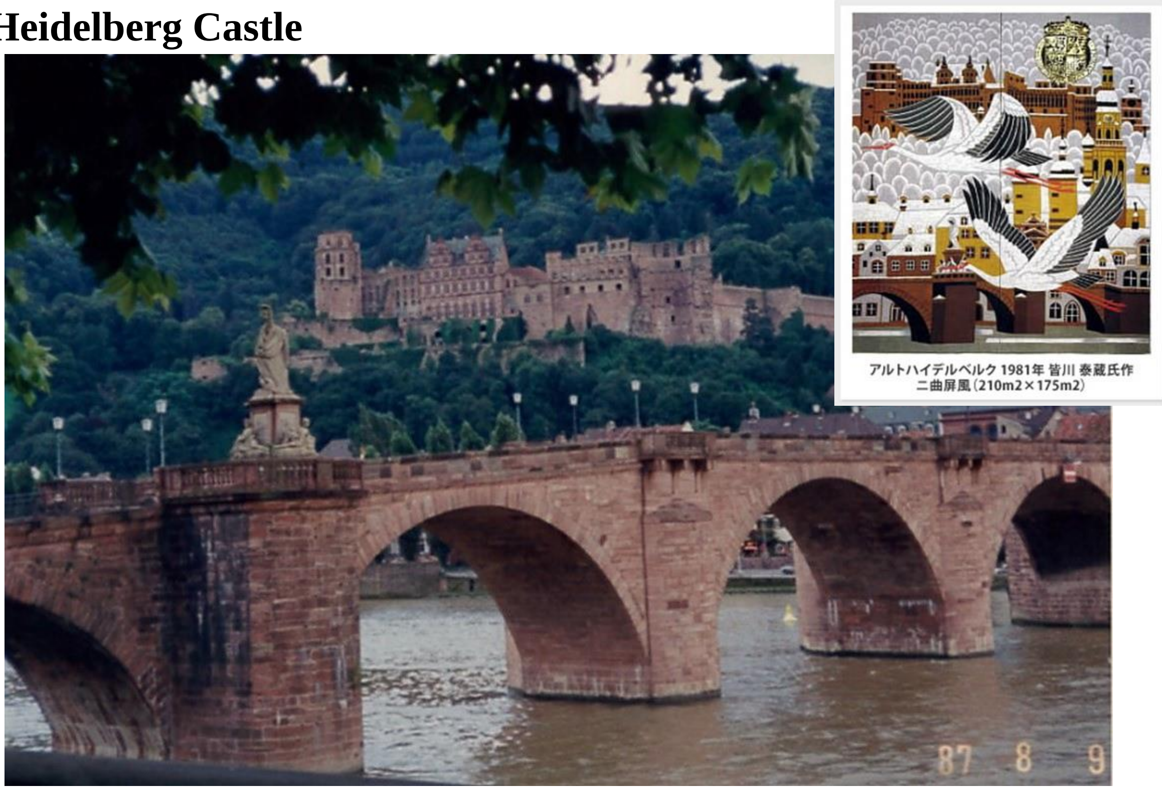
For various reasons, DST became a part of KAH, but after 6 years, K After six years, KAH was downsized and the question arose as to what to do with DST. Munters was interested in buying the company, but DST wanted Seibu Giken to take over the company. President Kuma and Managing Director Kuma made the decision to acquire the company, even though the management of Seibu Giken was not yet rock solid, and in 1993, DST became a member of the Seibu Giken Group. DST became a member of the Seibu Giken Group in 1993, which led to the company's later development.

KAH: Kraftanlagen AG. Heidelberg

Dream to the World

SGJ　Collection

Heidelberg Castle



アルトハイデルベルク 1981年 皆川 泰蔵氏作
二曲屏風（210m2×175m2）

This photo was taken in 1987 when President Toshimi Kuma, Executive Director Chieko, and I went to Europe to visit KAH in Germany. I took this picture on a holiday. Both the castle and the bridge look like they are made of bricks, but they are made of a beautiful salmon pink stone called Brutel sandstone from southern Germany.　The castle was destroyed here and there by Louis XIV's army in 1689. During World War II, the castle and its surroundings were not damaged by the war due to the recognition of its historical value by both German and Allied forces.　From this trip to Europe, Seibu Giken's technology spread throughout the world.

The picture on the upper right is a textile folding screen in the exhibition room of Seibu Giken, which coincidentally has the same composition as the picture.　This folding screen was given to us when we signed the contract with KAH.　The two storks symbolize the partnership between Seibu Giken and KAH.

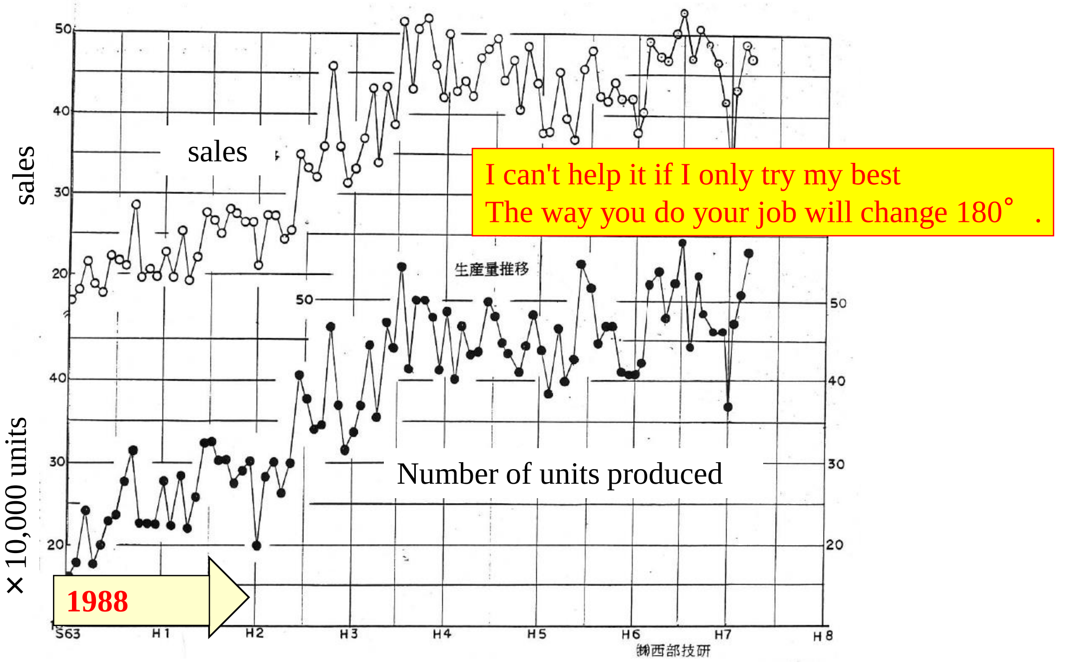
Unfortunately, Seibu Giken and KAH parted company after that.

However, KAH was the first to bring high-silica zeolite to Seibu Giken, which led to the development of the VOC concentrating rotor. And since DST was transferred from KAH to the Seibu Giken Group, it can be said that it was a stork that brought happiness to the company.

6. Production department

1987~1997　Rotor ⇒ Cassette ⇒ Honeycomb filter

Honeycomb filter sales and production volume trends



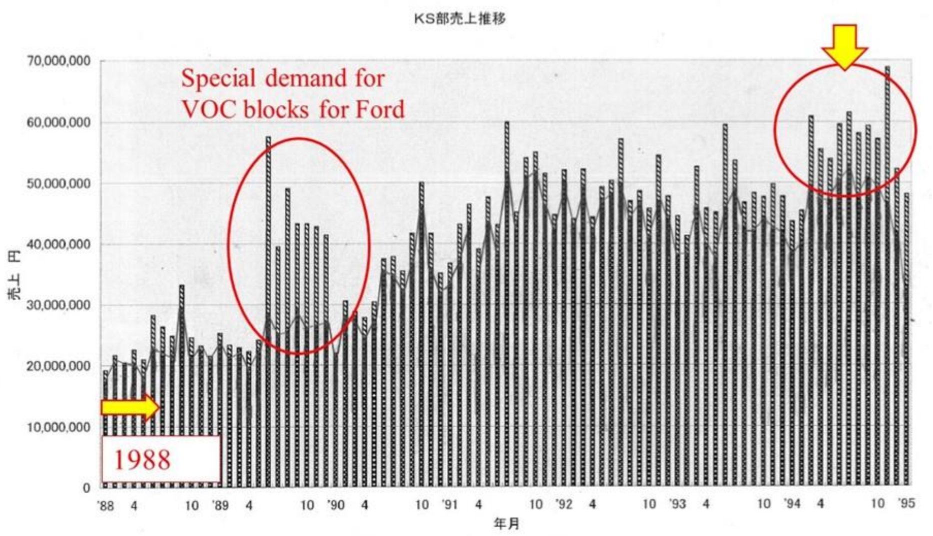
1988~1997　Honeycomb Filter Production Department

In April 1988, I was transferred to the KS Department (Toyobo, activated carbon filter manufacturing).　It was a bolt from the blue for me.　Activated carbon filters were becoming explosively popular as ozone filters for electronic copiers, and production was beginning to expand, and the rapid increase in orders was putting mass production and quality control behind schedule.　I was asked to do something about this situation.　I was worried that my experience in development would be meaningless in this situation.　Even if I could improve each problem by applying my own ingenuity and ingenuity, which is my forte, it would have only a marginal effect on improving the efficiency of this large organization.

Evening entertainment for Toyobo's sales, production, and development staff.　I have to deal with prototypes, product quotations, complaints, production equipment breakdowns, facility enhancements to increase production, inventory control, month-end sales totals, fights and injuries among part-timers and male employees, consoling those who wish to resign, and other various miscellaneous tasks that are completely different from when I was in charge of development. There is no time to concentrate.　　I was removed from development work, which I was good at, and did all the work I was not good at.　There were many times when I wanted to quit.　The situation in my department is also very difficult. One after another, subordinates want to quit, and it is hard to persuade them to do so. It is not easy to hire new employees in a dirty office. I endured it with a sense of responsibility that if I quit, the entire department would collapse, and with a sense of sorry for my subordinates who supported me.

Explore next possibilities while increasing production on consignment for T Corp.

New Corrugating Machine Developed High Cell Honeycomb
⇒Expanded to catalytic filters



Honeycomb Filter Sales Trends

Sales of the Filter Manufacturing Division grew steadily due to increased sales of ozone filters for copiers and other products. One lump peak in 1989 was the production of VOC concentrators for the Ford plant due to U.S. environmental regulations. This was special demand for the production of activated carbon fiber honeycomb KF blocks. To make up for the shortage of assembly space, we erected three or four tents in the plaza in front of the headquarters entrance, and since we could not recruit enough workers from the general part-time workforce, we even recruited foreign students to work part-time. The language barrier was a challenge, but it also led to international exchanges that will continue into the future.

Development of High Cell Honeycomb Processing Technology

At that time, the smallest honeycomb was AS-26, and there was a need for a higher density, high-cell honeycomb. We then completed a new type of corrugating machine and developed a high-cell catalyst carrier, thus setting the stage for the next era of honeycomb processing.

In the special demand for photocatalytic deodorizing filters for Duskin, we had no manufacturing site or facilities and insufficient preparation time. We borrowed equipment from other departments and prepared a production line while mass producing. We managed to cope with the production with the help of part-timers, part-timers, and support from other departments. We were able to start up a production system for more than 20,000 units per month in four months, but production was completed in eight months. Although we struggled very hard, we were able to turn a profit in total, and this technology was developed into the manufacturing technology for our next product.

Survived the bursting of the bubble economy in 1992

Danger⇒Stability

岡野次長 殿

平成５年１月３日

New Year's greetings

１９９３年　年頭にあたって

社長　隈　利　實

Last year, the company closed in the black.

我が社は今年で創立２９期を迎えます。昨年度２８期は異常な不景気にさらされながら何とか黒字決算ができるようになったのも皆さんの努力の賜物です。

振り返ってみますと、創業時（昭和３７年）は何一つ「ナイ・ナイ・ナイ・ナイ」づくしのスタートですから１９年間は非常に厳しい経営を強いられてきました。今考えますと身の毛がよだつようです。我が社のように新しい製品を開発し、商品化し販売するような独創的なベンチャー企業は日本では非常に育ちにくいと思われます。日本人の島国根性の

Very difficult management for the past 19 years
It was a painful 19 years that I don't even want to remember now.

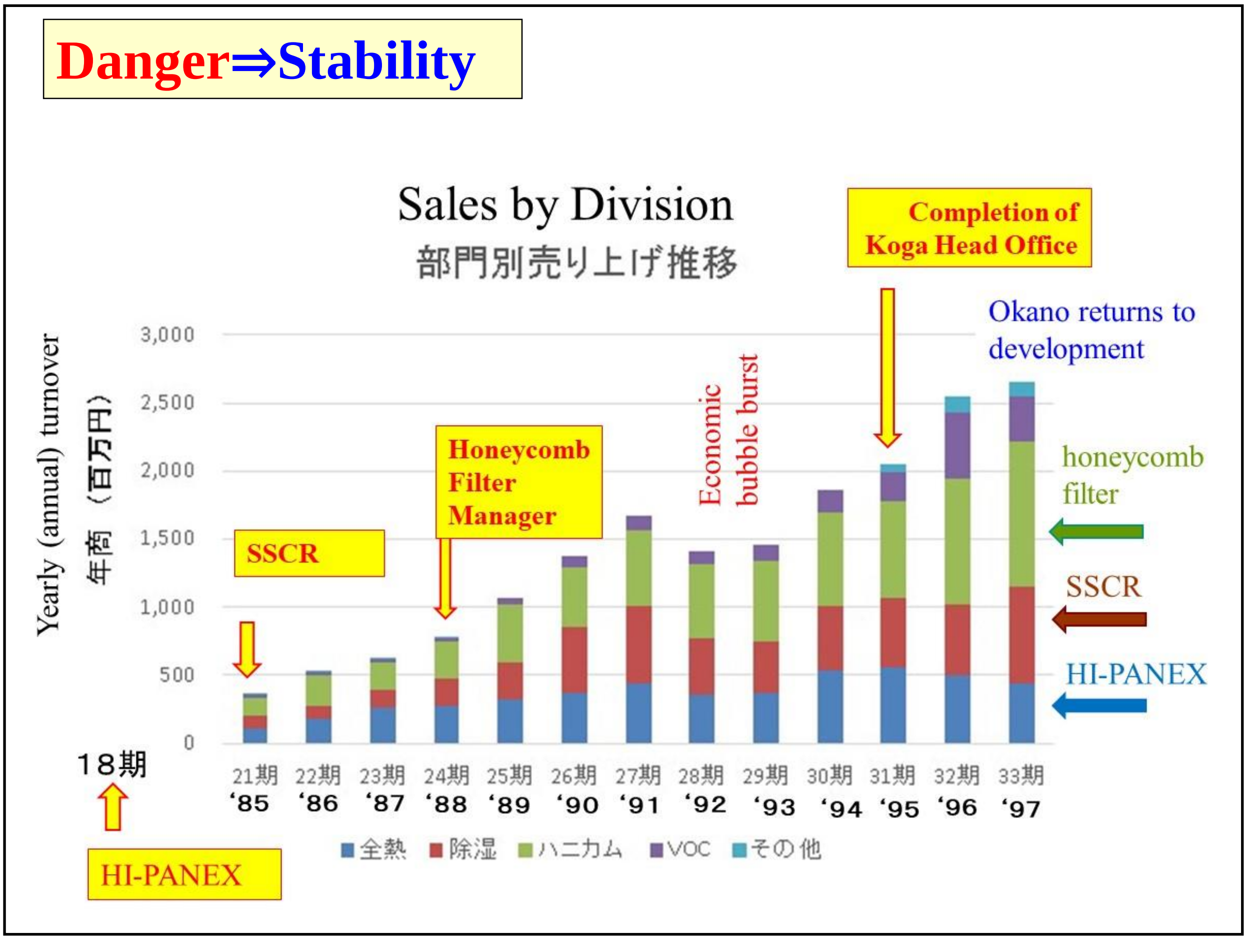
At the beginning of the New Year, after the bursting of the bubble economy in 1992, President Kuma distributed a copy of "1993 President Kuma distributed a copy of the letter "At the Beginning of the Year 1993" to each executive and instructed them to post it where it could be seen at all times. Reading it over now, I see that despite the very difficult period following the collapse of the bubble economy, our company posted a profit. The sentence, "When I think about it now, it makes my hair stand on end," describes how difficult the first 19 years of the company's existence were, but also expresses the excitement of overcoming these difficulties. At last, we have come to be called a company. The next sentence says that from now on, we will focus on sales and marketing.

President Kuma always said that we must increase the number of product technology pillars.

If we have several different product technologies, even if one or two go bad, one of the others will support them and we will not go bankrupt.

In addition to HI-PANEX, SSCR, and honeycomb filters, we now have more VOC concentrating rotors made of high silica zeolite.

During the construction of the new headquarters plant in Furukawa, President Kuma inspected the condition of the headquarters building, with its many sturdy pillars, and recalls saying, "This is how Seibu Giken's products and technologies should be.



Looking back on my first 20 years with the company, it began with a joint venture with Nittetsu Mining Co. To escape from the trap of a joint venture takeover of the company and to revive the company, we developed HI-PANEX. The development of SSCR helped us to escape from the crisis, while the honeycomb filter became a hit and stabilized the business foundation of Seibu Giken. Although the bursting of the bubble economy caused a temporary downturn, the development of the newly developed high-silica zeolite VOC concentration rotor put the company on a growth trajectory. In 1995, new Koga head office and plant, setting the stage for growth.

Around 1996, when I was still producing Toyobo filters at the old plant, I went to the Koga head office every month to report on the situation. President Kuma said, "The KS Department must reduce sales." He told me several times. Why can't we praise them for their good performance? Why would he say that? I later realized that it was because Seibu Giken's position with respect to Toyobo would be weakened if the ratio of sales to Toyobo increased too much. It was probably because of the bitter experience of the failure of the joint venture. Even if the development of HI-PANEX and Even if there had been no development of HI-PANEX or SSCR, the company might have been able to survive on a small scale with the production of Toyobo's filters. However, Seibu Giken might have been made a subsidiary of Toyobo. I cannot help but wonder again how many crises Seibu Giken has overcome so far!

Take on the development department

1996 Dinner with President Kuma and Executive Director Kuma

“There are no cowardly soldiers under a superior general “

‘ Performance Evaluation in the Manufacturing Department ‘

“Not a transfer to sales” (Is the sales department next?)

“We should have brought it back into development a little sooner.”

Resolving the challenges we face

1. Odor complaint for total heat exchanger

No competitiveness, little profit => “Withdrawal?”

1998 Development of "HI-PANEX-ION "

2.Ultra-SSCR short-term performance degradation problem

2003 Resolution ⇒ SSCR-U

On a holiday at the end of 1996, President Kuma and Executive Director Chieko invited me to dinner at a ryotei restaurant that evening.

President Kuma: "You did a great job in the manufacturing department for 10 years."

Me: "Thanks to the hard work of my subordinates."

President Kuma: "Followers take after their leaders; there are no cowardly soldiers under a brave general"

President Kuma: "Why do you think I called you here today?"

Me: "Are you going to be reassigned to sales next?"

President Kuma: "You don't need to experience sales. If you experience sales, you will only think about the immediate future.

President Kuma: "From now on, I want you to work in development again."

In April 1997, I returned to the Development Department to work on solving the difficult problem.

For total heat exchangers, Shin Nihon Thermo Lang had developed its own aluminum rotors to compete with ours, and we were losing the battle in terms of sales power and cost. Furthermore, every year there were complaints of abnormal odors, and the mood was for us to withdraw from the business.

In addition, the newly developed high-performance dehumidifying rotor "Ultra SSCR" was found to deteriorate in performance even during storage, but we were unable to solve the problem.

7. President Kuma's Last Wishes

1, Commercialization of mat dehydrator
2, Commercialization of DAFH
3, Reorganization of patents held

August 19, 1997 at the hospital

Died September 4, 1997

October 1997
Appointed as Director

Focus on stabilizing new internal structure rather than development

One day after returning to the Development Department, President Kuma, who until then had been in superhuman health, became ill.

President Kuma set up a fax machine in the hospital, where he received and sent daily reports of instructions to the designers of the "mat dehydrator," a development project that was to take up the last days of his life. However, President Kuma's condition worsened.

On August 19, he was told to come to the hospital with all the executives to see him, saying, "He is feeling a little better today.

President Kuma's last wishes at that time was 1-3.

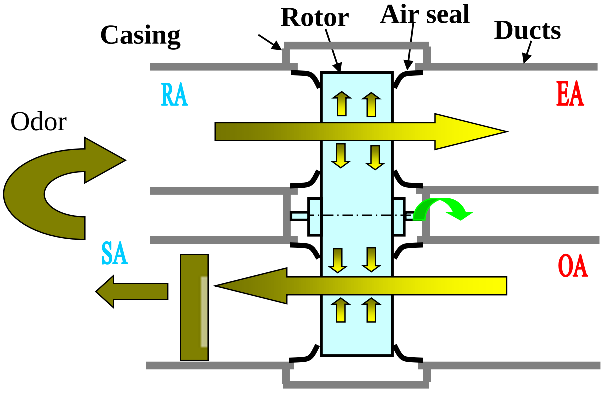
President Kuma passed away on September 4.

At the October board of directors meeting, I was asked to assume the position of director, which I accepted, saying, "I want to repay him by supporting the company at this difficult time.

In order to meet the expectations of new President Chieko Kuma, who said, "I hope you will do your best so that Seibu Giken will be seen as a company that can cope with the passing of its charismatic founder."

7.1 Countermeasures against unusual odors in total heat exchangers

Elucidated the mechanism of abnormal odor generation and the principle of ion adsorption type odor prevention



1, Odor adsorption and accumulation

2, Odor is released by displacement desorption phenomenon due to increase in outdoor air humidity

3,Odor returns with humidity, so odd odor does not disappear

When I first returned to the Development Department, I examined the development activities in the 10 years prior to my return. Among the themes that had been discontinued due to lack of positive results or were put on hold because I was busy with other duties, if there were any gemstones that could be further polished from now on, I thought it would be a loss if I did not utilize them as the legacy of president Kuma.

One of them was the odor-preventing total heat exchanger rotor using ion exchange resin.

The manufacturing method had not yet been established, test data was insufficient, and the effectiveness and mechanism of odor complaint prevention could not be explained

Development of HI-PANEX-ION

Be prepared to take risks

1998 Start of sales

2004 "Adsorption Society of Japan Technology Award

2009 Received "Monodzukuri Nippon Grand Award"

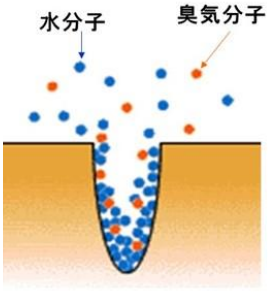
Proven effectiveness in preventing the generation of foul odors

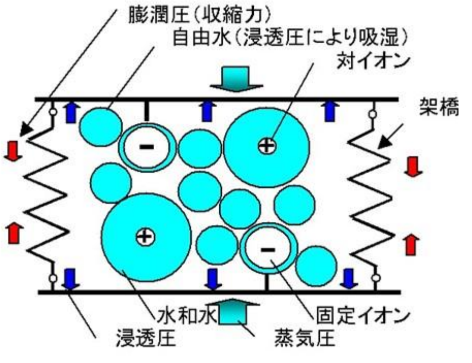
Seibu Giken's recognized technology

2004 Large odor complaint of more than 100 units made by another company.

Total replacement with "HI-PANEX-ION" eliminates complaints.

Silica gel → Ion exchange resin





Ion exchange resins are commonly used in water, and there are no examples of applications in gases. I deeply researched ion exchange resins. We realized that the keyword "ION" can explain the mechanism of hygroscopicity and odor prevention, so we proceeded to construct a theory and prepare materials in this direction.

Mass production is also an issue. Ion-exchange resins are more expensive than silica gel, and they are also expensive to pulverize. Moreover, impregnation support is also difficult. Therefore, I examined the possibility of production using the current silica gel coating machine. What are the costs? I was able to increase the production volume by replacing all the rotors with ION-type rotors and negotiated a special price for purchased materials, and finally succeeded in commercializing the product.

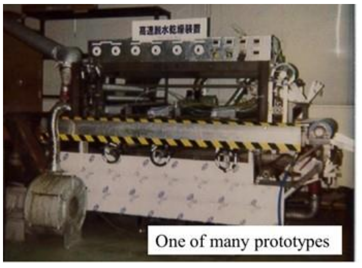
We had already confirmed through experiments that the system reduced odor migration during operation, thanks in part to joint research with the Fukuoka Institute of Technology, but we had no proof that the system was truly effective against the accidental generation of strange odors, which may or may not occur more than 0.1% of the time per year.

However, I knew that if I showed even the slightest concern, everyone would be concerned, and I was prepared to take full responsibility if something went wrong, so I kept my concerns to myself and proceeded with the project.

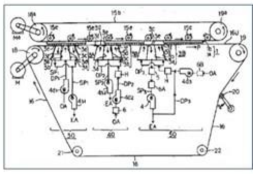
In the first and second years, I felt a weight lifted from my shoulders as I confirmed that no ION-type complaints had been received for silica gel products, even though there had been complaints of strange odors.

Around that time, we received a major complaint of an unusual odor from another company's total heat exchanger. The other company asked for our help and we replaced 100 units with HI-PANEX-ION heat exchangers. HI-PANEX-ION heat exchangers, and the odor complaint was completely eliminated. The odor complaint was completely eliminated.

7.2 Last wishi 1
Commercialization of mat dehydrator



One of many prototypes

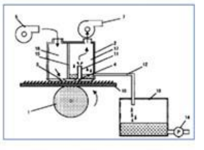


Product #1 continues to have trouble
Daily fax instructions from the hospital's president Kuma
Withdrew after the president passed away

Two years later, the second unit was commercialized. 2 units sold.

DUSKIN 1999

Solving a Difficult Problem



■November 1998 Appointed project leader to promote the commercialization of matte dehydrator

Last Wishes of President Toshimi Kuma 1: Commercialization of Mat Dehydrator

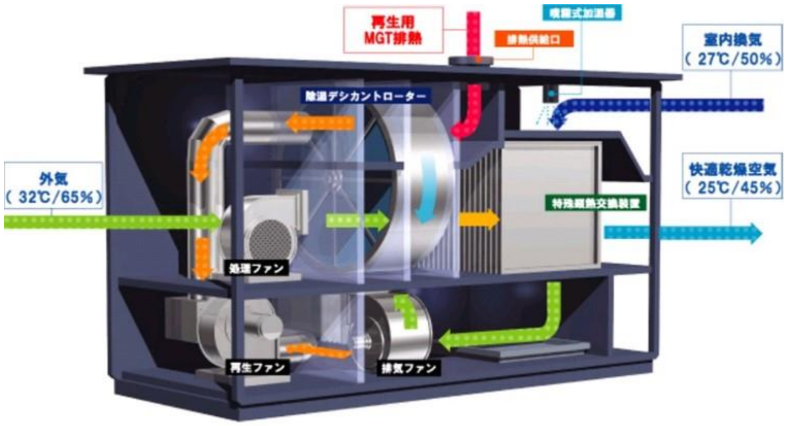
President Kuma was focusing on mat dehydrators as the next major original product after honeycomb. However, the first machine delivered to TR had a series of troubles, and SG engineers had to be stationed at the customer's site for about a year.

After President Kuma passed away, then Executive Director Fujimoto negotiated with Tokyo R Corp. to withdraw from the company.

As the commercialization of the mat dehydrator was the founder's last wishes and testament and was attracting attention from other companies, new President Chieko Kuma and Managing Director Fumio Kuma instructed the company to "organize the know-how, respond carefully to new enquiries and complete the development".

7.3 Last wishi 2 Commercialization of DAFH

DAFH incorporated Desiccant air conditioning system using MGT waste heat E-SAVE Commercialized



PAT 4607356
PAT 4749559

2002 "Technology Award" Separation Technology Association
2003 "Technology Award" Society of Chemical Engineers

While we were developing DAFH, cogeneration decentralized power supply was attracting attention as an energy-saving technology, and the development of micro gas turbine generators by the U.S. venture Capstone Corporation led to a boom in Japan as well.

The time has come! We will develop a new desiccant air conditioner E-SAVE combined with a micro gas turbine exhaust heat utilization specialized for DAFH. The E-SAVE is installed for desiccant air conditioning in the entrance lobby of our company, and demonstration operation begins. At that time, it attracted a lot of attention and many visitors came to see it.

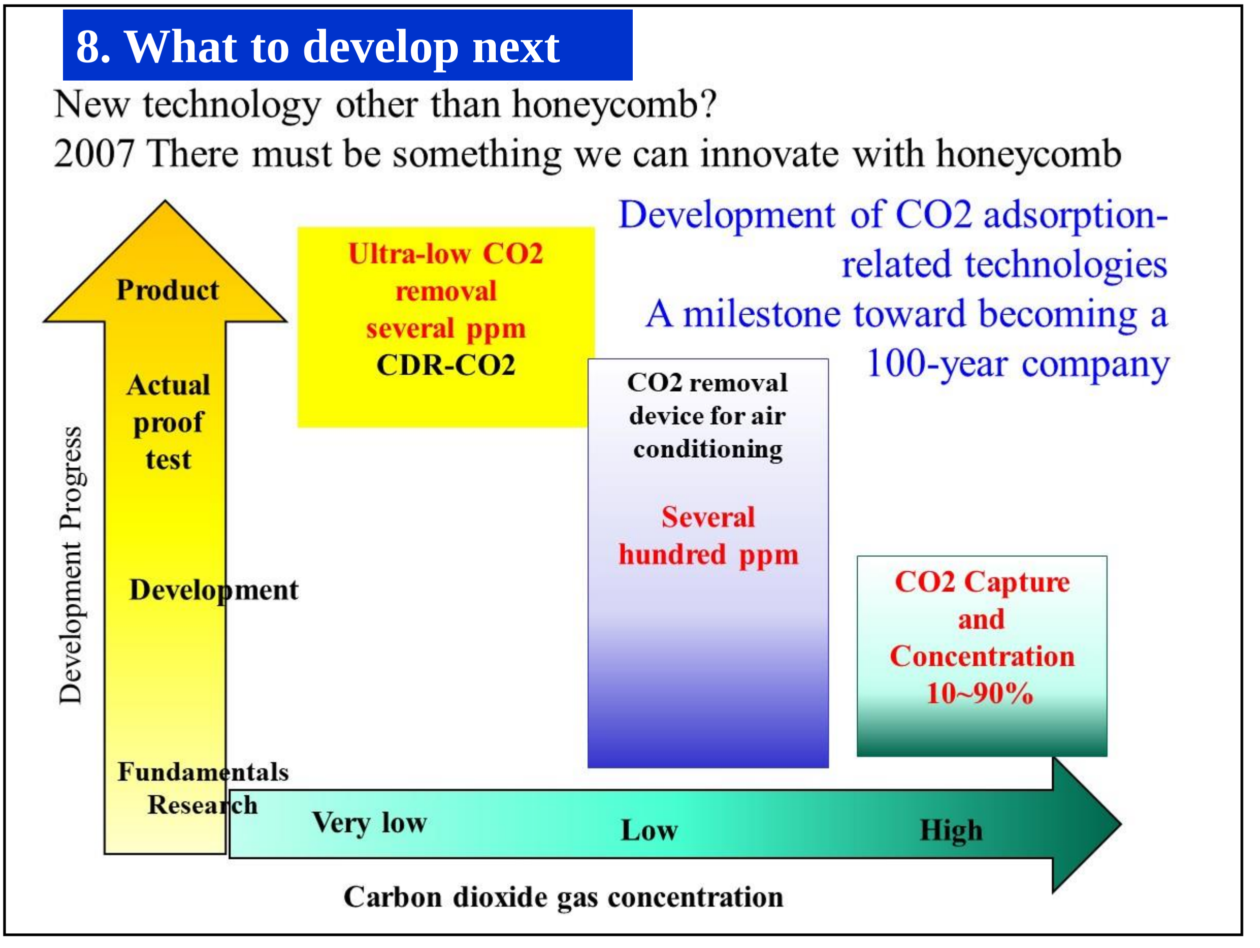
Thanks to the efforts of our sales and design staff, we sold 20 units of our original DAFH-equipped desiccant air conditioners, but with the end of the micro gas turbine boom, we discontinued production and sales of this product.

Developing an original new product is difficult, and the success rate is low.

You are forced to choose between working hard on research and development, knowing the risk of failure, or taking the easy way out and suffering in the quagmire of cost competition.

However, while it is easy to develop a new product without originality, it will ultimately be lost to a competitor in a low-cost country, resulting in a bloody battle.

We believe that "originality and fusion" are necessary to grow into a century-old company.



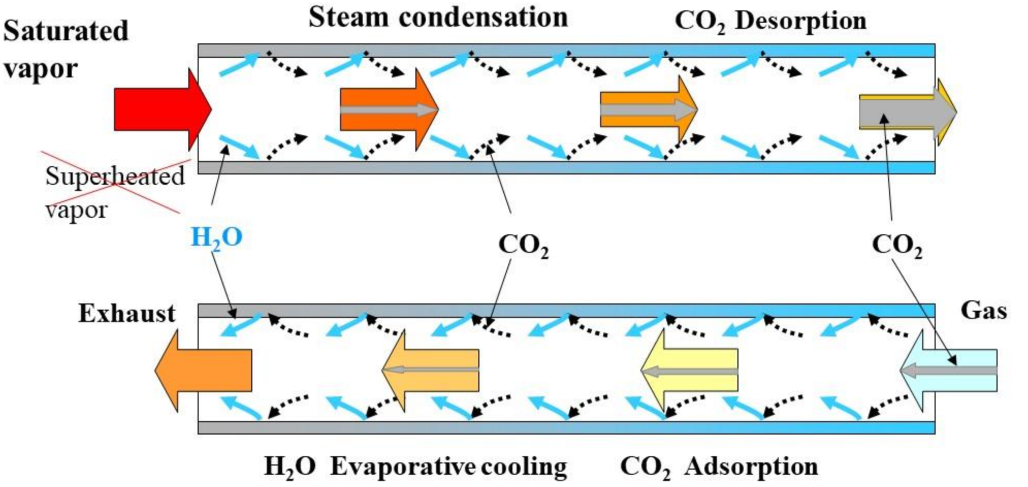
What should our next goal be? In 2006, when I was wondering if I should finally consider themes other than honeycomb, I visited the Toyota Commemorative Museum of Industry and Technology in Nagoya . I had thought that the textile industry was an old, technologically mature technology, but I was shocked to learn about the history of technological innovation. I felt that honeycomb technology had reached a dead end, but I was encouraged that we should continue to pursue "innovative honeycomb technology," which is one of our strengths.

Therefore, we started with basic research on CO2 removal technology, an idea we had been warming up to since 2004. Currently, CCUS technology is attracting attention worldwide from the perspective of global warming prevention, but there are still many issues to be addressed and it will take time. I expect that there will surely come a time in the future when we will be glad we developed this technology.

In order to develop and disseminate original technology, we felt that it was necessary to change the common sense and perception of the economic and industrial world, so we made a presentation at a conference to gain public recognition. We also tried to obtain public development funds from 2009 to 2017. I tried seven times and lost out. However, I am proud of this record.

Original innovative technology development for air and water science

Wet Thermal Swing Adsorption



PAT : 6181835
64080802
6510702
6605548
6603299
6632005

Okano method of thinking until the end
We are competing with a group of talented people and advanced equipment from a large company.
You can't win just by working hard. You can win by being creative.

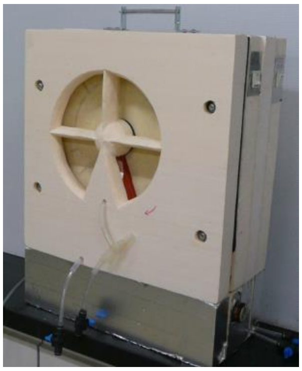
Breakthrough: A challenge to the "innovative wet TSA method"

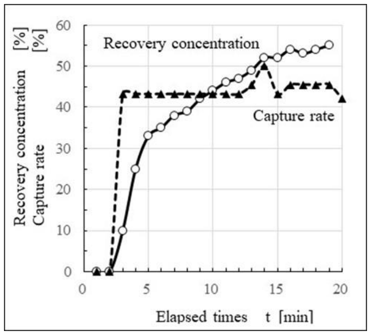
In the conventional TSA dehumidification and VOC concentration method, the adsorption heat is generated by the adsorption of water vapor and VOC vapor, which reduces the adsorption capacity. In addition, water vapor gets in the way of VOCs other than dehumidification, and especially CO2. During adsorption, water vapor is adsorbed first, reducing the amount of adsorbed CO2, and conversely, during desorption, energy is wasted in desorbing the adsorbed water, hindering energy saving. Furthermore, there are theoretical barriers and it is impossible to economically concentrate a gas with a dilute concentration such as atmospheric CO2 to nearly 100%.

Since 2010, we have been conducting joint research with a certain major, but we have been unable to make a breakthrough and have reached a dead end. At the final meeting in February 2012, we proposed the idea shown in the above figure in the hope of continuing the research. Unfortunately, however, the joint research has ended.

After that, we continued to search for a breakthrough for many years. In 2016, we came up with the idea of using hot water for desorption, but no one agreed with us. After writing the specification myself and asking the patent officer to apply, we experimented with the possibility. In 2017, while I was trying and failing, I remembered the idea shown in the figure above. However, this was also a unique idea and no one agreed with it, and no one would believe it unless I prototyped it and demonstrated it. This time, I wrote the specifications myself and asked the patent officer to do it. I modified a test machine that was going to be disposed of and repeated the experiment. It was possible to concentrate atmospheric CO2 to a few percent, but it was not a superior performance.

9. Start-up venture





G.V.Lab. Hiroshi OKANO

Global Volunteer Lab.

In 2019, I retired as a director and continued my research as an advisor. In 2020, I was asked to become an auditor for Seibu Giken Co., Ltd. while continuing my research, so I became an auditor. However, in order to ensure the independence of the auditor, there was no budget, and I later learned that I could not hand over the development results to the company. Therefore, in between work, I continued my research using unnecessary items and waste materials, personal funds, etc. Since I could not use carbon dioxide gas cylinders, I conducted experiments with atmospheric carbon dioxide. At this time, I was finally able to confirm that the test equipment in the photo showed a high concentration of CO2 recovery of more than 50% from the atmosphere. (Top right Fig.)

In May 2021, I made the demonstration test using a prototype machine public to the directors and development personnel. However, the response was that the Okano patent would be difficult to put into practical use and commercialize, and that the company would not develop it or need it. Since the company cannot issue patents, I notified them and filed the application at my own expense.

I want to contribute to ESG on a global scale with this patent technology. He also promised to remain as an audit and supervisory committee member "until the company goes public," so in 2024, the year after the company goes public, when he turns 71, he resigned from his position and founded a venture company, G.V.Lab.