A: In the UK, no.
M: It is in general accepted.
A: Yes. And, they have worked hard in the individual organisation. So if you could go to one factory and they do not have behavioural safety, so people are not safe. But if you go to factories where they have it, they all like it. It would be very difficult to introduce it quickly. It took literally a generation of people to make the change. Because people in 1974, I started practicing in 1988, I met people who would say, "well I am deaf. So it does not matter. And I am not going to wear ear defenders." Or I am a paint sprayer, and I would get lung disease. Now they are educated. When they come out of the college, they learnt how to be a paint sprayer. And the young people are the ones who want to wear the protective equipment. So it has taken 40 years. It is, how do you say, Kaizan?
M: Kaizen（改善）.
A: Small steps.

Y: そういう流れになってきたというのは、コストを抑えることにつながるからということもあるんですか。
S: Do you think this behavioural change is related to cost savings for the employer?
A: To some degrees, yes. We put a lot of effort into the Olympics in 2012, the Olympics. And we built the stadium and all the Olympic village. It was the first ever Olympics in the world, where nobody died in the construction. And they put a lot of effort into it. They work into, um, the level of behaviour was ... They gave canteens to the construction workers and encouraged them to eat breakfast. Construction is not a safe industry and has a tough man culture. People would come to work and they gave them cheap breakfast, so porridge for a pound and so cheap breakfast, so that they would have full stomachs because that effects their behaviour. They say it reduced the accident rate, making sure everybody was full. It is a health promotion and they did various costing, and I do not have the figure but they say it paid for itself.
（日本語説明・確認）
S: How do you raise safety awareness through education?
M: From elementary school?
A: Not from elementary school but from college. So some college and university they would get safety as part of it. But also what we have had in industry is the IOSH, the other safety organisation, Institute of Occupational Safety and Health. They have training as well as the BOHS. They have what they call a managing safely course. It is a one-week course, but specifically for managers. And there has been a lot of that training. Previously, people who were managers had no safety training. Now, most of them have safety training.
S: Is it still voluntary?
A: It is not compulsory under legislation. You will find the organizations make it compulsory for their managers. I cannot name the companies but the companies I worked for they have made all their managers do IOSH "managing safely." One of the difficulties with behavioural safety is that it tends to be more orientated to safety and not to health. It is easy to spot safety problems like no ladders, no protection and no barriers. It is less easy to spot health problems.
M: To spot?
A: To identify. So you might easily tell me off for not wearing safety glasses. It would be more difficult for you to look and say I am not using the LEV correctly. I can also see the risk with the safety glasses because I might get bits hit into my face. But if I inhaled welding fume, I would still go home fine. It is the difference between chronic health disease and acute safety

accident.
M: Now it is midnight in Japan.
A: So you are tired. (Laughs)

S: Are they many health and safety consultants like you in the country?
A: Yes, there are. The BOHS has a register. These are the people who would do health risks, hazardous substances, noise and vibration. There are about 100 companies. Some of them have only one employee, and some with 10 employees.
S: What about your company?
A: It is only me. There are also safety consultants, who would be on the register with the IOSH, the other organisation. And there are quite a few hundred of those.
S: What is the relationship between this other organisation and the BOHS?
A: They are separate but close. Safety people are very safety orientated. They do not go into as much detail as we do on the health side. Equally, I know nothing about machinery guarding and pure safety risks. I can talk to you a lot about ventilation, dusts, noise, solvents, vibration and things that would affect your health, but not a lot about how to peel the floors.

M: It might be difficult to answer. But, how much money do you get from a company for consulting?
A: It is difficult to answer. With ventilation, companies do not want to pay for the consultation, which is one of the problems. They spend anywhere between 1000 and 100,000 pounds on ventilation. I have seen people spending 100,000 ponds and taken no advice. They have not consulted with anybody and they just trusted the salesman. And, they have been sold something for 100,000 pounds, whereas I would have charged them 1000 pounds for some advice. And, they would have got something a lot better. But I had somebody who wanted me to give advice. I said I would come and I would spend a day and go up to Newcastle –so it would quite a bit of travel– write a large report and specification they can give to their suppliers. And I think it was about a 1000 pounds but they did not want it. They have gone off and decided to try to manage it themselves.
I had another company. They did not ask me anything. It would have cost them less than 1000 pounds. But they spent 30,000 pounds on something that does not work at all. They bought a down-flow booth. Do you know a down-flow booth? They have been used in the pharmaceutical and food industry. It is a booth where somebody were working and air fed in from above. So all of the ceiling flows the air and it is extracted from the back. And it is filtered and re-circulated. And they spent 30,000 pounds on that. But it was not big enough to fit the equipment in.
M: It was a waste of money.
A: Yeah. It was a waste of money. It was for mixing flour in the food industry. So from the side view, these bowls are wheeled in. The fresh air is here. But this bit, all the dust was coming out. That is one of the biggest problems we have. People still buy things that ...
S: They just trusted the salesman.
A: They just trust the salesman. Equally, you will get a salesman who come and sell you something cheap. You can buy for 500,000 pounds a portable all-the-extraction system, so one of these flexible arms portable. It might do the job if you have got the right circumstances and that the person does not move. But equally you might need a tip extraction, the extraction on the welding gun. But some people buy the wrong thing.
S: But, do they not complain to the salesman who sold wrong things?
A: It is culturally very difficult. If

somebody buys them a wrong thing in the factory, nobody wants to hold up to the mistake.
M: Nobody wants to have a responsibility, you mean.
A: Yes. Nobody wants to. You blame the person who left the company. It was "their" idea.
S: That is terrible.

Y: 40 年前から日本とは全然違う安全文化の方向に進んでいるんですけど、そのきっかけは何だったんですか。
M: それはローベンス報告というのがあったんですよ。
Y: それがそもそものスタートラインですか。
M: そう、そうだと思います。
S: He is asking, what was the motivation for this behavioural change or what was the cause of it?
A: Yes, we had the Robens Report.
M: What was the motivation for the Robens Report? Why did they have that meeting or something?
A: The Robens Report is older than I am. It is quite a while ago. So, I was only small. The motivation would be the number of people suffering ill health and dying in the country. So when you look back in 1974, we had coal mines, railways, we had pottery industry, big rubber industry, big steel industry, many accidents and lots of ill health.
M: So, Sir Robens and people had a committee.
A: Yes, in the UK, we have 3 political parties but mainly two who have been always in power. One is the Conservatives. They do not spend any money and do not chuff people very much. The other one is the Labour, for the workingmen, socialism, looking after people, looking after employees. They are directly funded by the trade unions. So, at the time, they would have been influencing and wanting the Robens Report.

（日本語説明・確認）
A: A the time, there would have been ... in 1974 and before, everybody in the country would have known somebody or have a relative who had had an accident or were suffering from ill health. Not so now. More people work in offices. But, I knew my granddad or my great uncle did not have a thumb because he lost it in an accident. There would be lots of people like him in the past.
S: So, at that time, was it Wilson, the leader of the Labour government?
A: Yes. The Labour government has been more socialist and on the side of the trade unions. This is, the Labour government introduced. We have the NHS, national health system, which is all about looking after people. We oscillate between the two. The Labour government get in and do nice things for everybody, and the Conservatives has to come in and sort out the economy.
（日本語説明・確認）
M: The UK situation made this Act 40 years ago. It is not the other countries.
A: No. It was our own situation, which was very different then to what it is now. And, I do not think there was any long-term plan. I think it was "we want to have this" and they could not see. And because bits in between 1974 and 1988, there was other legislation but it was about bigger accidents. Comer, a major chemical plant and doing risk assessments on those, it was stopping the bigger accidents before they started to look at small accidents.
（日本語説明・確認）
M: After we go back to Japan, we might have other questions.
A: Yes, that is OK.
S: He asked the questions he planned to ask. But he is not very tired.
A: Yes. I can understand. You can take them all, but most of them you can download.

M: How many pieces of guidance do you have like this?
A: There is big guidance for the whole of COSHH. It looks thick because it printed out on one side. There is one for that, and there is also one for the whole of COSHH. And these, for individual processes, there may be 200. Maybe a hundred or two hundred. They took a long time to prepare over time. And I think the International Labour Organization, they adopted some of them. So they have taken them on. John Saunders would be better able to tell you. I know there is one in the brick industry and there is one in rubber. There is welding, bakeries, and so on.
M: You made 200 guidance in 20 years or so.
A: Oh, the COSHH essentials have started...
M: In 1988?
A: No, no. It is COSHH legislation. But it started small. It was just that much. And, companies had to get used to it. Back in 1988, there were an awful lot of people and all they did was did just collect data sheets on their chemicals, but did not do proper assessments. And it took a long time for the industry to get used to proper assessments. This was started to try and make simpler for the industry. This was started about 2000.
M: 2000. It was about 10 years ago.
A: Yes. COSHH essentials. There is a big emphasis on trying to make health and safety accessible to small businesses.
M: Control banding?
A: Yes, this is control banding.
M: For small companies?
A: Yes. So, there is a website and if you go, they ask you all sort of questions about what you are doing, and then through the logic process of the software, they say this is what you should be doing. So they ask you what are you painting, are you using solvent, and information about solvent, and they will tell you which of these sheets you need to apply. So it is not just the controls but the logic of the software.
M: Not skilled people can do it.
A: Yes. So you would go and it would ask what are the health and safety phrases for your substances are. That kind of things.
M: The Japanese government people said the other day they would like to do this control banding system. They want to install the Japanese control banding system. But we say it is very difficult to directly introduce it.
A: Yes. Not everybody agrees with it. And, sometimes it gives very funny answers. Equally then small company comes and they put all the data and they look at the sheet, and say I cannot afford to buy that.
M: Anyway, it is up to the company management.
Y: Can we now take a picture please?
A: Yes. I am quite happy to take a picture.
(1 hour 45 minutes)
Thank you and good-bye

(2) Meeting with experts of the Occupational Hygiene Unit at the Health and Safety Laboratory
1pm on 21st November 2013
at the Health and Safety Laboratory, Buxton, Derbyshire, UK
Attendees: Mr Tim Roff (unit manager), Dr John Saunders, Dr Helen Chambers, Murata, Yonemochi, Umesawa, Saji

（会話途中から）
S: 作業者が何をやっているのか、どういうことをしているのかというのを書いて、どういうことをしているところに換気装置をつけたいのかというのをメーカー側に伝えて、メーカーがそれに合わせて作る。という風にしたいから、そういう動きになっている。それを recommend しているそう。それでもまだ、既製のものを買って取り付けることもできるけど、それではよくない。
（時間の確認）
J: The legal framework in the UK, the legal side,
H: Did Adrian talk about this is the way we control substances.
M: It is COSHH.
H: Yes. COSHH. Do you know about that?
M: We know about that but not precisely. We know the name of it.
H: OK. This is the regulation made under the Health and Safety Work Act in 1989 at first. It did not come, it was not easily accepted. And nobody really understood what it meant.
M: Nobody understood.
H: No, it was not back in 1989. Now after 17 years, it was better understood. But this is where it says you need to use ventilation just as part of controlling exposure to hazardous substances. Ventilation is only part of controlling workplace exposures. So that is in there. But then, John and Mike Piney and the HSE worked on this book. Have you seen this as well?
M: Yes.
H: Did Adrian show you this? OK. That is it within that. So you know about that. That is good.
S: (question?)
H: In the UK, that is what hygienists work, these two. We have done training on this kind of things.
S: I see. But, what he was saying was after this Enabling Act in 1974. This was introduced in 1989. What happened between 1974 and 1989? Was there a sudden change? Do you know anything?
H: I do not know. Because it was before my time.
S: Was there any other legislation?
H: There was Factories Act.
M: Factories Act.
H: Yes. It was from 1961. And it had some or a little bit about controlling exposure.
J: There was also LEV guidance in the 1970s, I think. There are two documents. There was HSG 54, which was about maintaining and testing. And there is another document on introduction to LEV. But, to be truthful, they were not targeted at an audience. They were factory correct and good information. But they were not kind of drafted for an audience. So they have been replaced with 258. They would be in the 70s. Were they?
H: Yeah.
J: It was used from the 70s right through 2000.
M: Audience?
J: Audience could be different from suppliers, employers, and employees.
H: People who would know about regulation difficulties are in the HSE, really, Health and Safety Executives. You would have to maybe speak with people in the actual regulators because we are not regulators. They would know more. It is just who to speak to. I think it would probably have to be some kind of policy department.

J: Maybe telephone conference or something.
H: Yeah, email them to start off with to get that information, if it was available. It might not even be available. There is a lot of documentary evidence like those factory inspector's reports. Factory inspectors used to do a report every year, the chief inspector of factories. They have quite a lot of information about historical situations in there. There are in our library, and I am sure there in the British Library as well.
S: Another thing he said was, for example, if an accident happens right now, and the company already some systems, who is to be blamed? Whose responsibility would it be if anything happened in workplace? Is it for the employer's responsibility?
J: Yeah, the employer.
M: The employer?
H: Employees also have the responsibility, certainly for asbestos. In COSHH, there is some regulation to do with the employee's responsibility. But mostly the weight is with the employer. Then it can be the supplier.
M: Supplier of LEV?
H: Yes. They have responsibilities and liabilities as well, and consultants as well.
M: Advisors?
S: Like Adrian?
H: Yes, like Adrian, and we are as well as the HSE. Mike Piney was actually prosecuted for some consultancy he did as a job. So it depends.
J: It is not common. But the HSE can prosecute the advisor and the employer maybe.
H: I have got to go. I have got to give a training course. It was good to meet you. We can always correspond by email. John and I closely work together.
(Take a picture with her and John and others. Helen leaves.)

M: You inspect the ventilation systems and see workplaces.
J: Yes.
M: How many times do you have to inspect?
J: The factory inspectors are a number of officers around the country. So they are at different locations. And they will look after their area. There are not many inspectors, compared to the number of places. So they do not and they cannot inspect every year. On average, 7 years between each one. But sometimes they react to inquiries. Maybe somebody reports something, and then they have to go to the place they were reporting it. It may be LEV but they would cover, the inspectors would cover everything. They cover noise, they will slips, trips, falls and also heights.
M: Not only LEV.
J: Not only LEV. So they have a good knowledge of everything, but an in-depth knowledge of LEV. So if they see something and if they think it needs further attention, they will get back or get in touch with specialist inspector, and that was Mark Piney's role. And Mark Piney is an occupational hygienist with an interest in LEV. And, they would ask Mark or somebody like Mark. May be in the UK, there may be about 10, 10 people who work for the government and who have specialist knowledge. But also there may be another 20 who work on exposure testing. And there would be specialists in different areas. And they would then go to the site and look at it and write a report. In that report, they say it needs improving and issue them a letter that tells you need to do something about it. If it is really toxic the material, and if it is in theory, they could issue what we call a provision notice. That stops the work there. They cannot carry on. Maybe to ought to carry on working if they get the right protection, maybe, air-fed or air-powered ...

M: Plus knowledge.
J: Yes. That is how the inspectors go round. They would also react to the people writing in, like "I think there is a problem in this place." So there are not enough inspectors to go to visit everywhere. But each company that has LEV, under COSHH that document has ensured us there is a requirement, statutory requirement, legal requirement to have the local exhaust ventilation system tested annually.
M: Exactly annually.
J: Every 14 months. But essentially annually, every year. The employer may not know enough about their own ventilation system because maybe they are a baker or a welder. They do not know much about LEV. So they often pay an outside company to come and check it. And the company would go round and measure airflows, pressures, and check the fan, check the filter and they would either say it is passed or it is failed. Now, to be honest, that does not work very well. It does not because I may decide if I were an employer, and I may decide I am not going to get it done this year because I have got not enough money or I forget or I do not know about it. So, not anybody has it done. Only a fraction has it tested. Of the ones who do have it tested, people who test it practically go through very quickly. It is not thorough. You know, it is not thorough. The aim of the test often is, they measure velocities, they measure airflows, they measure pressures and say, yes, same as last year. But the problem is, it is not a good system. It is not designed properly for the process. It is leaking all the time and they miss it and look at the engineering side. So it does not work as it could do. And, often, when it is installed, nobody is every checked if it works properly. Somebody would have say, "I designed the thing to move this much air." But nobody would have said it does only move air but controls the exposure. And, nobody would have checked if it is the right design. So you often see an LEV system that costs a lot of money with a big filter banks, very good filters and, fans, very good, and almost a tin box on the end. And that is not doing a very good job. So if the hood does not contain the contaminants that are collected, the rest of the 100,000-pound system is redundant. It is not doing anything, apart from wasting the energy by the fan moving. That is what we very often see. In 2006, we tried to improve LEV in the UK. What we thought was, how could you improve it? What and how would you do to make it better? What we thought was, one was the specification. Make sure, when you are buying an LEV system, what you ask for and write something down, and say this is what I wanted to do. So you agree with the specification. And also you see in the UK, systems like 300,000-pound systems with no instructions. It would have been designed for the factory. But there is no instruction. So the workers do not know how to use and interact with the LEV. And the manager and the owner, they do not know how to maintain it and keep it running. What we should do now is to provide the user manual. Literally, when you buy a car, you would have a user manual. That shows you a diagram, tells you the part, tells you how it works, what you need to maintain, what replacement parts need. So it gives the owner the ability to maintain it. And this, it sounds silly. But a lot of the systems are installed in factories, with no real understanding. It is just to switch on the wall. They do not understand. So, that was another thing we thought, user manuals. That is included. But it is not a regulation or legal requirement. It is guidance. The other thing we thought was, a lot of LEV systems start to fail gradually.

Nobody knows when filters are blocked. Nobody realises. What we thought would be good was to have a monitor on the hood.
M: A monitor?
J: Yes. You see it on fume covers, a gauge on the hood that tells you if it is performing. So we say every LEV should have some sort of real-time monitors. You immediately know whether it is working or not. Because many LEV systems, for example, in wood working factories, there may be 10 hoods, but only 5 of them are used at any one time. And workers need to know which ones they can open or which ones are closed. So the system is not designed for all 10 hoods, but it is designed only for, say, 5 hoods. So the workers need to know how to use those hoods. So we call it an airflow indicator. It could be a pressure measurement and is usually a pressure measurement behind the hood. And if you measure behind the hood, the hood static pressure, anything you change downstream will affect the hood static pressure. So if the fan starts to slow, the pressure of the hood will go down. If the filter is blocked, the pressure will go down. If there are holes in the system, the pressure goes down. If the hood itself blocks upstream, the pressure will go up. So it gives a kind of real-time indicator.
M: And they understand if LEV is OK or not.
J: And, ideally, you would install these when you install LEV systems. But you can do it retrospectively. You can do it afterwards.
M: What was that?
J: Ideally, you install the gauge when the system is new. But the reality is people do it afterwards. And, at the moment, it is a relatively new requirement.
So the other thing we thought was commissioning.
M: Commissioning?
J: Commissioning the system. Because many systems are designed, so I design a system and I draw it, all they do when they install it is to check the flow rate. They do not check whether it contains or capture the sort. So what we say is, you should commission the system, which includes installing it, checking that the system actually moves the air as you designed it to move. And the most important thing, the third one is to say, "Does it actually control the exposure?" And, you need to check that. And the way that is checked depends on the system. So it may be checked with a smoke, if it is a small system and maybe low toxicity not dust, check with the smoke, and say yes, that works. If it is dust that is produced or fibre or mist, you can use a dust lamp.
M: Dust?
J: Yes, dust. A strong lamp. Have you seen that?
M: Yes.
J: We still use it a lot to visualise, and you can very quickly see whether the hood is working or not with the lamp. So that is one way of commissioning. And the more kind of quantitative way, more with numbers, you could do is a personal sampling. You could install a system and do a personal sampling to make sure that you are below the exposure limit. You may want to do, maybe something like a containment testing where you release a contaminant in the hood, it could be a surrogate, maybe a gas, and you detect. When you release it in the hood, so it is a 100% capture. And when you release it at the process, you can measure the downstream and get a percentage capture or maybe breathe them. So it is a surrogate. It is easier than to do with a real pollutant. But you could also do it with a biological monitoring. So it could be a urine test, depending on the pollutant. Or a blood test. A blood

sample. You do that once in a way and you do that to make sure demonstrate the system is working. Once it is working, you have got your velocities, you have got your pressures, and as long as the process does not change, and you do not move the hood, that should work. And you maintain that each year. Yes, in theory, you check it each year.

M: Do you mean this testing is a requirement from the HSE?

J: That is in the guidance now. Not a statutory requirement.

M: Oh, just the guidance.

J: Yes, the guidance. But, in the COSHH, it does say, I think the term they use is "the initial appraisal." In other words, it is in there, but it is a little bit... People misunderstand what it means. So we are trying to be clear in the guidance. But the only legal thing you have got to do is a full examination test annually. The reason it does not work is because people install the systems that are not well designed, never really work. At the end of the year, it is checked, it is moving the air, and, exposure continues, continues and continues. Personally I think the commissioning is the best test. If you get the commissioning right, you just need to maintain it.

S: You said companies ask the system manufacturers to do this commissioning?

J: Yes, commissioning can be done in house. But, often, it will be the LEV supplier who commissions it.

S: So there are some people who do the commissioning.

J: Yes, they will be usually the suppliers of the equipment. Now, some equipment is standard. So the commissioning is much easier. So if you have a standard product, for example, a fume cupboard is fairly standard. You know.

Y: ドラフトですよね。

M: In a laboratory?

J: In a laboratory fume cupboard, yes. It is standard. There is European standard. It is EN14175. And I have sit on the European committee. And, that is the standard that manufacturers would follow. So if they want to mark their cupboard as meeting the EN, they will have to make it of the sort of material, it would need a sash, it would need all the things you would expected from a cupboard. And many companies then... because that is made as a production it would have a containment test done as a type test. So they will test one of the cupboards and check if it does what it expects, and then they will sell hundreds and thousands of those cupboards. And, often, they will say they manufacturer recommends you run this at, say, 0.4 meters per second at the face or 0.5. And that is fairly standard. So we have got 30 fume cupboards in our lab now. And when we had to install we had a containment test carried out to make sure they would work. We've done once. That is it. And every year we check velocities at the face. As long as they are the same every year, we do not have to re-commission it. We do it once. The beauty there is that, as long as the process does not change or you do not do something very energetic in it, it should work. But the good thing about the containment test is it checks the whole room. Because it checks the drafts, if there is a wind or air movement across the face and if it spills, then the containment test would pick that up. And also it tests a make-up in the air, you know where the air is coming into the room. So it is quite a nice test. And so you see less problems with fume cupboards like that. And the hoods we have the most problems with are the movable arms, the capture hoods. (It is like a .... drawing) This is flexible.

M: A flexible hose.
J: And the hood is here. The process is maybe here. Because it is very prone to drafts or any air movements. And the workers do not recognise you have got already small areas of air bubbles around. And so we fine these misused. The hood is over there and the process is over here. And that is very very common. We prefer not to use these ideas.
M: Not to use.
J: Not to use it. But, everybody does. Most companies do. And lots of these go back to companies who were rushing into the LEV. Jumping into the system. They have a problem and then think "I need an LEV." They go out and buy an LEV. And these are sold out of catalogues. And people think, oh, it is moveable. I do not have to alter the process. The process can remain the same. I just have this hood that comes in. And what we say is you need to think about the hierarchy of control. So the first step should be not to think "I need an LEV," but the first step should be, "do I need to use this pollutant?" Can I eliminate it? So if it is a powder, can I use pellets instead? Or, rather than adding a powder, which could become an airborne, could I have a liquid? So the problem goes. S you encourage the companies to think about, can you eliminate it? If you cannot eliminate it, can you substitute it with something else, for example. The next step would be, can I change the process to reduce the emission? For example, maybe, you are emptying a powder into a vessel. It hits the bottom, dust everywhere. Can I change that? Maybe you have a sock that you put the powder through. Training. Good training. Rather than dropping it from high, carefully low. So the problem goes away. So we encourage the companies to think about eliminating the problem. Sometimes you change the process, then you do not need an LEV. Or, you enclose it. I will give you an example. In bakeries, flour is not very dusty actually. It clogs together on its own, flour. Sometimes you can just enclose it. So the particles are airborne but not respirable, often uninhalable. So, they are quite large. They settle. So just by enclosing it, when you do a personal sampling, the exposure can fall dramatically. And then you need a small amount of air, not a lot of air. So you encourage the companies to think about the process. And maybe rather than having lots of different sources, you would bin all the sources together, and minimise the exposure. Then the exhaust ventilation has a better chance of succeeding. Unfortunately, a lot of companies do not do that and jump to a local exhaust ventilation. So that is the kind of snapshot or image of what is happening in the UK at the moment. We are trying to change that with the new guidance. And there are now some associations that have been set up. And now there is an institute of local exhaust ventilation engineers.
M: 昨日言ってた話かな。ILEVE?
J: It is the ILEVE. The institute of local exhaust ventilation engineers. I saw the chairperson this morning. And the idea here is that you join that association as an individual, not as a company, and you would become competent by passing exams and gaining better qualifications. Then the idea is that, when they go out in the industry, when I say I would want an LEV system, I would ask for an ILEVE person, somebody who is a member of the ILEVE, because it ensures me I am getting a good standard, that is competent and would work. So, the industry, hopefully, out is reacting now to the guidance. But a lot of the systems in the UK are not off the shelf. A lot of them are a kind of bespoke around the process. So if somebody comes in, it is a

designer's one-off. Nederman, Aerovent (?), of all these companies who sell these, are most cumbered. We think of them being not as good as they could be. So we are saying "close them" as much as possible.
M: At a workplace, when they do not have LEV, they must have LEV. But you do not have things like catalogues. You recommend to see a person and then they can install a suitable LEV. Do you have any catalogues of LEVs?
J: Yes, the manufacturers of LEVs have catalogues of different sizes of hoods. Some of them make different down-drop dentures. And they make different types. But a lot of companies...
M: You can choose one. But it is not an effective way or appropriate way. You need a person, a competent person to select an LEV.
J: Yes, yes. Often, ones that have been put in in the industry, they were not bought out of a catalogue. Somebody would have come and look at it and designed it. So it cannot be bought out of the shelf. But, for simple things like welding or soldering, you can buy different systems. So, for welding, you can buy a hood like this. Or you could go for an on-torch extraction. Torch extraction.
S: Adrian explained it yesterday.
J: Ah. So the extraction is built into the torch. It is useful in shielded gas arc welding. It does not stop them welding.
M: We also have the system in Japan. But the workers say it is heavy. So they do not like it.
J: They used to be very heavy. You cannot use it for a long time. But some of the new ones are better. They are plastic and have a swivel joint, so ergonomically better. But ones that are most effective are small ones, air-cooled torches. Water-cooled ones are not as effective.
M: Adrian yesterday said you would show us something in the laboratory.
J: I think it is gone back. I will check. I will ask people to check. I can show you pictures definitely. But the way it is tested... This is a practical hose. And you have the fan. So that is a fan and filter. The trouble with these we found was there are leaks at joints. So the best way of testing them is to put something over the front, and then measure what goes up through the torch.
M: Measure what?
J: Measure the flow. There are lots of leaks in this type of system. So that is the old way of doing it. The most common way is this way. But for fabrication welding, it is very difficult because you need to keep repositioning the hood all the time. So there are other systems. Enclosures with the extraction at the rear. So you weld inside a small enclosure.
M: Weld inside a small enclosure.
J: Yeah. It is like a partial enclosure. It is a little bit like a fume cupboard.
M: What about big structure welding? For example, ship. Big ship.
J: Ships. I have seen these tools. And the extraction is built into the gun. Sometimes you will see on the big ship. And, when you weld, they were allowed to fume to rise. And, in the building, people stratify out. So this is clear air. Clean air comes in here. Slightly cooler. So it is displacement ventilation. And, it moves upwards. And here it stratifies. So this would be contaminated air. And, this is relatively clean air. So the workers of those ships keep them away from being there, because it goes upwards, away from them and clean air comes up. I have seen an example in Swedish company (??), and it is OK.
M: What about the exposure of the workers?
J: They are here, and the fume rises.
M: I see. There is no exposure.
J: But, sometimes, you have to accept,

when you are welding a large item and you are welding moving from a position to position, unless you have an on-torch extraction, which is good, you would end up requiring an RPE. So they often wear a respiratory mask.
Some of them are air powered. They are often air powered. So they will have filtered air. It filters the air and supplies it to the mask. But there are options and on-torch is good. For robotic welding, you will see a canopy hood above because there is no workers there. So for robotic welding it rises into the hood.
M: How about the cost of the system? For example, on-torch extraction or RPE.
J: For the long term, paying for the mask everyday can be very expensive. And the on-tool extraction is used at a high pressure, so it may be 12 kPa. So it is very expensive for electricity because of the pressure you have to overcome. And they fill often the filter and return the air back to the weld place. So you have got the cost of running it electric and you have go the filter costs as well. It can be expensive to run. But it is more expensive to rely on general ventilation because you need dilution, a lot of air. And the air that comes in has to be heated or cleaned and cleaned again before it goes outside. So it can be cheaper still to control at source.
M: That is a kind of general ventilation.
J: That is general ventilation. We call it displacement rather than mixed.
M: Replacement?
J: Displacement. So air comes in quite cool, low down and extraction is higher. And it gradually rises. Often there is a heat source put in the room. Then you get a relatively clean area and you get a stratification level. As long as that stratification level is above head height, then it can be effective.
Y: これイメージできないです。
M: これは船を作っていて、ここで溶接をしていて、きれいな空気をここから入れて、下から。で、溶接の fume が暖かいので上に上がる。
Y: なるほど、なるほど。
J: Sometimes you have to... It is very bespoke to the process. If I keep it boating, for example, there are very nice yachts, the expensive yachts. They are made of fiberglass. When they lay the fiberglass, the workers are in the boat. In amongst the source, the emission is coming from all over. So it is very difficult to ventilate that. Then some companies use a push-pull. So they blow clean air into the boat, and extract it from the other side. There are different ways of doing it. You have to choose the one most appropriate. But the regulations do not give you advice on that. They just say you must control. It is up to you how you go about control.
M: You must control.
J: Yes, control exposure.
T: Yes, it is not prescriptive. You should show me you control, then you can control.
M: If they cannot control the fume, what would happen?
T: Breathing apparatus.
J: It is the last line of defence. The last tool for breathing. The idea is you do not jump into breathing apparatus. It is the same as you do not jump to an LEV. You follow the hierarchy. If you are using masks, you will accept your failure of control. You cannot control it. That is the last resort because it only protects the person. It is not come to the bulk. Sometimes you have to wear masks. If I can give you an example of spraying cars, you spray it in a booth.
M: Spraying the car?
J: Yes, paint spraying. That would be carried out in a booth. And that booth may cost 40,000 pounds. And it uses a lot of air. But when you look at the structures of the air inside, they do not clear very quickly. So the worker still

has to use air-fed breathing apparatus. That is because often isocyanate paint they use and it is a potent asthma agent. What the booth does is to protect the people outside the booth, but not the worker. It reduces their potential exposure by dilution. But it does not offer a full protection. So they have got an enclosure and put the worker inside the enclosure. And, there are standards for spray booths.
M: Standards?
J: European standards that have been developed. That would try to get a level plain field. So if you comply... if you buy a booth that has passed the European standards, then you hope you are buying something of a better, quality one that would offer a better protection. So there are standards out there, but not many. Ones I can think of are fume cupboards, microbiological safety cabinets, spray booths that have standards. And, pharmaceutical companies have developed their own standard between themselves where their test systems are using powder.
M: Pharmaceutical companies?
J: Yes. The powder they use would be lactose powder. It is not yet ... Then they can look for dermal (exposure), and they can measure lactose fairly easily. That is the way of checking their control. And that is the standard. That is the standard developed by the pharmaceutical industry. That they will have within the pharmaceutical industry because it is often quite potent, quite toxic maybe the substance they are using. They will have ... Some of the controls are off the shelf like down-flow booths. So it blows air down over the worker and extracts through the rear. It is like ... (drawing a picture).
J: Air comes in from here. It is extracted through here. And that is filtered. And then there is a standard for these, I think, as well. They work very well. And the work would stand here doing the process. They may be still work. This is some kind of more expensive control option than just a hood. So this blows air in and extracts there, and here there will be filters. And some of the air goes round and some of the air goes outside.
M: Some goes round. Clean air.
J: Yes. These would be filters. High efficiency filters. 99.997% effective. But these have to be gauged as well. These are expensive. 20,000 pounds.
M: He works with some pharmaceutical powders. If he acts some ways, he would be exposed to some powders. Maybe.
J: Yes. Maybe. This is what we say. As long as hardware, this is software side. The software side is the working practices, training, because no matter how the LEV is, if the operator does not know how to use it, it would be a poor system. So they go hand in hand. So you need to check the system but also you need to understand the working practices.
M: How do you guarantee the software side, I mean inspect it?
J: Inspectors would ask, can I see your training records?
M: Training records.
J: Yes, you have got the training records. And they will ask the workers, how do you use this system? But there are only, as I said, there are only a few inspectors for lots of industries. Under COSHH we mentioned earlier, it talks about control options are sweeter controls. It is a blend of controls. It is not just LEVs.
M: It says?
J: Yes, it says that. Actually it says in the regulations. It is working practice. It is training. It is maintenance.
M: そう書いてあるんだ。
J: It is a blend of them. An LEV on its own would fail. It is a mix.
Y: ちょっとだけ質問いいですか。ここの

ところで、単にフィルターだけではなく、何か物質を分解するようなものを入れているんですか。
M: Is there a catalyst, he says. Is this a process for powders?
J: It could be a die.
S: He is asking about the filters.
M: Is it a catalyst? For example, is it a gas?
J: It is powders.
M: Not gas?
J: No. It is easier to filter powders or dust.
M: Pressure? Pressure gauge?
J: Pressure is used across the hopper. It is easier to filter powders and dust than it is... Whatever filters you use, you need to know it works. So, every year, as part of thorough examinations and tests we talked about, you would expect someone to check the performance and maybe with the real time instrument. Or, for example, in a clinical dispersed oil penetration test, you release something you need to test. The trouble with the vapour deposition is it often may use lateral carbon filters. They fail quite rapidly without knowing. Personally I do not like to filter vapour. Vapour is too dangerous to get it outside. You can buy, we talked about a fume cupboard, and you can buy a re-circulating fume cupboard. Take the air through the front and then we will have arms. Then we will have a photoionization detectors built in. A PID is built in to detect when it breaks through the filter. So some of them will have a HEPA filter, with a pre-filter, a HEPA filter. Then we will have an activated carbon filter. Then we will have a sensor, another activated carbon filter. So when it alarms, you still have got a safe barrier. But not all. Some of them have only one filter. So it all depends on the manufacturer, and up to what they have chosen. Lots of companies now want to recirculate the air because of energy costs. Because of cost of heating and ventilating. So companies now looking more at reducing the flow rate were still carrying out operations safely. And they wanted to recirculate. So they have to be careful if it recirculates and ensure that it is proper filters because if it fails to danger. But you would not normally filter powder or substances that are carcinogens or asthmagens. We do not normally filter that. You normally, it filters but it is normally discharged outside. You would not normally use it for recirculating.
Y: I see.
T: I wonder if there is a scope for training materials or discussion aids for training in the longer term. John runs various training courses. You do not normally do long-distance ones. But you do normally do video conferencing or whatever. We could consider doing some sort of training using visual aids and that sort of stuff. It does not have to be John there are a number of other people who do training course.
J: It has been lots of training developed over since 2006 guidance came out. It has been a lot more training developed because we have seen a real need for the training to make put a stress back on commissioning and less on testing because the testing would never pick upon the or any faults. So there are lots of courses now. There are, maybe, 6 or 7 courses are now recognised as courses for training. Some of them are training employers, and some are for managers.
T: What is the regulatory framework in Japan? Do you have, like the HSE, any inspectors?
M: We have inspectors. But they inspect whether or not people obey the law.
J: It is similar to the UK, I think.
M: Similar to the UK. But the regulations are ...
T: More prescriptive? Do they tell you exactly what you have to do?

M: We have prescriptive regulations.
J: In the UK, we are moving anything away from that. In any guidance, it does not say flow rates. It just tells you design principles. These are the principles. But they do not tell you speeds. A few guidance sheets do, but not many. Most of it tells you the principles of control, and how you go about it is up to you. Not as prescriptive.
T: I would have thought a prescriptive solution as a danger. You can either over control or under control. So you can take too much air away or not enough air away just because you set the limit what the flow rate is and so on.
J: That is the thing about the EN standards. They tend to tell you what you must do. But a lot of them are product standards. So they try not to be designed too restrictive. If you say, you do it this way. Then nobody thinks new ideas. Whereas, if you say this is the principle you have got, then people 'ooh, hang on' and come up with innovative ideas. So the EN approach is not to be too prescriptive, and it to allow designers to think of new solutions. Have you seen ACGIH book? Did Adrian show it to you?
M: ACGIH? In the USA?
J: Yes, USA. That is a little bit like a recipe book. You know, the solutions are in there for specific operations. And in the UK we do use that. We have not got our version of that. So, in the UK, people do use that because there are values in there. There are some designs there that work.
M: It is easy to install prescriptive way.
J: Yes, yes. Their CGIH book used to be one big, thick book, did not it? Have you seen it? It used to be one book. Now they are separating it into two. One is for design, and the one for management. So it is a little bit like in the UK. We have done the same. We try to separate in terms of management.
M: Management?
T: Again, that is some of the things we do. About a quarter of our business is commercial business. But some of the work John's team did in the science laboratory show that we went to test and verify the fume cupboards were working. They were operating but you were able to demonstrate that actually there was not 100% control and, actually, some of the contamination of the building was actually coming back into the building. So if you test a fume cupboard, it did everything that you designed it to do. But something was happening. That meant it was not controlling. Actually it was not working safely. It was just working. So it was quite interesting one.
J: That is the beauty of the containment test. It picked upon the fact that the discharge was coming back into the building. There was a damaged duct. And it was coming back into the line. So ...
There was some work done in the 1960s, I think it was in the UK, in the ceramic industry. I cannot remember the exact phrase for the work. I think they called it "tows (?)." It is a certain process that you do when you are making a ceramic plate. There was a very high rate of silicosis from the silicone. Very, very high rate. This was probably in the 1960s. What they did in the industry is that they designed a solution for each process. So they designed a bespoke solution. And they put a lot of effort in it. And what they found was, for the exact temperature you did a process with the place like "towing" I think you call it, you clean and polish it, it was done in a small enclosure. And they knew that if they got half a meter per second at the front, it would work. So they did not have to check everyone. All they needed was to check the flow rate. They did not have to do personal

sampling because it was such a nice and elegant design. It just worked. So as long as it is maintained and the process was the same, they did not alter the energy of the process, if it was the same process, then that would work time and time again. But there are not many industries where you can do that because processes are slightly more energetic. Or, one company is doing slightly different from another company. But in the ceramic industry, because it was exactly the same process almost like a production line, they designed one and rolled that out for the rest. It worked. That is an example of an "off the shelf" solution that does work. But there is not many, not many.

M: What about the foundry? There is a mould made of sand. And they melt metal and pour it inside it. And they break the mould to get a product. Is it foundry? Am I right?

J: Yes.

T: Do you know anything about them?

J: Yes, they have instructions. But I must admit that Helen and her colleagues have been doing a lot of work the foundries. So they would know more than I do on the foundry side. But, yes, there is a risk of exposure to the silicone.

M: Yeah.

J: When they break the mould, they put an additive to bind the sand together to form a roll. I think they call them knockout boxes where they break it up. There is an LEV control element in there.

S: Is there a kind of standardized LEV system?

M: Standardized?

J: Some of them are. Sometimes the size of the mould is in different size. So there is always something slightly different. But you can buy any... When you think about large engineering, when for the laser that cuts large metal sheeting, and they have under table extraction. It is a big, big, bigger than this room where the metal piece sits on the laser that cuts it out. That is a fairly standard approach. You have the same approach probably everywhere. And the extraction is under the table.

M: Extraction from the table.

J: Under the table, yes. It is because, with that process, you are, the process is driving fluid downwards anyway. It is cutting it through. So there are different approaches. But there is nothing in the legislation that says you must do this. There are some, we have some online help. It is called COSHH essential sheets. It just gives basic advice to the workers and some of them will suggest an approach. But a lot of them just say you need to consider and look at ventilation. It does not tell you what type they should use.

M: If we would like to see some examples of ventilation systems, for example, this downward ventilation system, where can we see?

J: I am thinking of the big, heavy kind of industries. These would be the companies who installed where they need to cutout. Maybe you need to contact companies.

M: We must visit companies?

J: Yeah.

M: Or, can we see a video or catalogue?

J: I have got no videos of one of those. We have lots of other videos but not one of those. I am thinking of, or if you think of any companies that make large quarry machinery, you know, like tractors and diggers where they would need big metal sections, they would cut that out on the table. And the extraction is there underneath. And there is a fairly uniform approach. You will have a certain speed around it through the table. You know companies like JCV and Caterpillar. They are big.

M: JCV and Caterpillars, are these company names?

J: Yes, Caterpillar. Any of these big

companies would manufacture those large industrial vehicles. They would have a cutting table to cut out.
T: So, what is the purpose of your investigation or research or whatever? Are you working for the government or something? Are you working for the Japanese government?
M: We had a grant from the government for research.
T: What is the research question?
M: The government wants to install the system for ... They want to do this type of emission control.
T: But, you must have some control in workplace. You must have some now.
M: They would like to know now. They would like to know what is the effective way for LEV. Or, they want to control the situation.
どういうふうに、新しいシステムを動かしていけばいいのか。局所排気装置が今は法律で決まっていて、これから法律で決まっていないものを導入していいことになったけれど、じゃあ、どういうものを導入していいのかということを。要するに何でもいいですよ、というわけにはいかないので。
S: 具体的なものを知りたい。
M: 今は具体的なものをひとつ一つ認可しているんですよ。ひとつ一つ。そういうふうにすればいいのか。
S: Previously, the government specified the LEV system. You have to have this type with certain measurements and things. But they are trying to be more flexible. As long as the LEV system is effective and working, companies can introduce different systems. But they want to know how to approve of, or the process of approving new types of systems.
M: Company managers want to cut the cost of ventilation systems. But the trade union or workers union do not like them.
T: I wonder whether we could do something, I do not know, if we could support in some way.
M: Maybe you had some hard time after 1974, installing the new Act.
T: I do not think the Act replaced a lot of prescriptions in the lots of industries. I think it is the LEV that moved with.
J: The COSHH is the main one. I think the problem is, in the UK back then, a lot of systems were designed and installed. But there was nobody to check whether they were working. They just checked the engineering function. They checked whether it moved the air. They never really checked whether it controlled. That is the key.
Velocities are fine. But do they actually control and contain the pollutant? That is the big thing. That is where commissioning comes in.
S: 機械的にはちゃんと動いているけれども、実際に有効に有害物質を排除しているかどうかはチェックしていない。それで、コミッションニング（commissioning）というシステムを導入しようとしている。自分でテストしたり、尿検査したりしているということですね。
T: For the inspection, the Health and Safety Executive go and inspect. They do look at something. Does it look right? And they test smokes and see where the smoke goes. That is easy to do. But, to check if it really controls, you have go to do something that is expensive relatively.
J: It can depend on the system. If it is a very, very simple system, you may be happy with the dust line from the smoke to show that it works, and record it. But if it is something like asthmagen or something, you may want to go a little bit further and make sure by personal sampling. You can do that, you can do that at the commissioning stage. You may wish to do it every two years or three years after. You make sure it works.
T: It is a proportion of risk. We have government science labs in the UK. We

have got a category 3 microbiological lab here. Some science labs in the UK are testing government research, very, very toxic chemicals and biohazards here. Clearly they need to show control to a much greater, much higher degree. Then, for somebody using a chisel with a stone, it is different.

J: It is kind of matching the control with the level. That is the truth. But, in the past, when the inspectors were not well trained, they did not know what to look for. So they saw lots of metal works and lots of hoods. So they have just used, "Oh, have you got a certificate of annual tests?" Then if it is "yes," then it is fine. So there was lack of checking.

M: So everybody could check.

J: Everybody in the industry. The industry was not particularly building good systems. The employer did not recognise the testers not picking up on the fact. The inspectors did not have the skills and the equipment. In fact, testing was a challenge. They do now have smoke tubes. They have dust lamps. They have anemometers. So they are equipped. So, in the UK, there have been over 400 inspectors trained on how to recognise the problems.

T: This was not post 1979. This was only about 10 years ago. So I do not think it was not the move from prescriptive to a more free (voices are overlapping)... I do not think it was the cause.

J: Years and years ago in the 1980s, they did have anemometers. They gradually fell to disuse. And it is almost in 2006 and in 2007 when we trained the inspectors.

S: In the years between the COSHH in 1989 and the other in 2005, was there any problem?

J: There were problems. This is from where I came up this morning, from the presentation. Somebody was installing an LEV brought from a manufacturer. They did not understand the COSHH. They went out and they sought for assistance. But they saw a disconnection between the COSHH and what is really happening. This is what they should do, but what was really happening was different. So it is not have a big impact on the LEV, as the HSE would have hoped. So you saw a lot of systems that the employers spent their money on designs. But they were not really the best designs. And they were not really working as well as they should do. But, every year, they would be tested. And, every year, they would get a certificate to say it is moving the air. But they would not address the fundamental problem of all, the wrong design to start with. Or, at least, it is not controlling the exposure. So, my opinion is, come back to the machines and get the commissioning right. Demonstrate and document. And, then on, it would be easier. Wait until you spend £300,000, and test it in the end is the wrong way, I think. But that is a personal opinion.

M: The same situation.

J: I think, in Ireland, they are writing their regulations, I think, at the moment. They are considering whether they go for a legal requirement for the test at the end or whether to go for the commissioning at the beginning. I do not know which way they are going for. But I do not think they will have a legal requirement to test because legally you have got to maintain it anyway. Within the regulations you must maintain it. It is a duty to maintain it. So it is already there really.

M: あとは事例だね。

Y: 事例が見たいですね。

S: They are hoping to see some LEV systems you have or something in the lab. Testing systems?

J: At the moment, we have got two test chambers. One has got a commercial job in. The other one we are setting up for is we are looking at plating. So it is

electrical plating. So plating nickel onto a metal. So we have got an example there. We are not commissioning it but just checking. That is a research project. Looking at the ways that it controls fume from the plating and the electrical plating bath. So, I can show you that.
S: Do you have any DVDs that they can see?
J: It can be easier I can send them, and find out which one is most appropriate afterwards, rather than looking at them now. And, I can send them some pictures of the gun, the torch. I am not sure if we got one in the lab at the moment. I am working with the Germans and a French on that project. We are collaborating. We are trying to write an EN standard, a European standard on, just on torch extraction. So we are trying give guidance. I know the French are rewriting their guidance on it because theirs is very prescriptive. They are going to change a little bit. Theirs said, you must, from the torch, extract 100 cubic meters per hour. That was it. And the found it all depended on how much leaks you have got and how you designed it. So they are going to change their regulations or the guidance.
M and others: Umm.
T: OK. Shall we go downstairs?
(1 hour 13 minutes 10 seconds)

2. シリカゲル光触媒を用いた有機溶剤の分解に関する研究

2.1 目的

工場や事業所等では、数多くの有機溶剤が接着・塗装・印刷などを目的として使用され、低濃度でも人体に影響をおよぼすことが懸念されている。そのため、工場等から排出される揮発性有機化合物をはじめ、人体に有害な化学物質を使用する現場において、局所排気装置等の設置が義務付けられていた。しかし、平成 24 年 5 月 17 日基発 0517 第 2 号「有機溶剤中毒予防規則等の一部を改正する省令の施行について」により、改正が行われた。この改正により、一定の条件下で局所排気装置以外の発散防止抑制措置の導入が可能となった。つまり、有害物質をその場で処理できるような装置を導入することが可能になり、そうした局所排気装置以外の発散防止抑制装置の開発及び導入の機運が高まっており、本研究でもその目的に則した分解装置の開発を目指している。

有機溶剤の効果的な処理方法として、有機溶剤を燃焼し無害化する燃焼法が主流であるが、処理装置が大規模になりやすい、環境負荷が大きいなどの問題がある。もうひとつの処理方法として、活性炭による吸着法があるが、高除去率ではあるが、あくまで吸着であり分解はしていない点に加え、吸着能力にも限度があり、活性炭の再利用が必要になるといった問題がある。

そこで注目したのが、光触媒の酸化力を用いた分解法である。光触媒分解は、光（紫外線）の照射により、有機物を安全かつ容易に二酸化炭素と水に完全分解する性質を有する。燃焼法や吸着法に比べると分解速度は遅いが、常温常圧で分解を進めることが出来、時間をかければ環境負荷をかけずに完全分解できる特性を有しているため、高処理量でない現場や、より簡便で小型な装置が求められる現場では、光触媒分解法を用いることができるのではないかと考える。最終的には、光触媒を用い、密閉空間を循環させて有機溶剤濃度を低減させるようなシステムの構築を目指したい。例えば、現在社会問題となっている胆管がんを発生させた印刷工場における有機溶剤の作業環境への拡散防止である。つまり、印刷作業時、印刷機に付着する有機溶剤の除去に用いるウエス（布）が、使用後、ウエス容器に捨てられるが、ウエス容器に拡散防止対策が施されていないので、ウエス容器から有機溶剤が拡散することへの対策である。

光触媒の研究は、これまで粒状、繊維状、格子状光触媒など、様々な形状の光触媒材料の作製を行ってきた。本研究では、光触媒の課題である、処理効率の低さを改善すべく、吸着剤としても使用されるシリカゲルに光触媒を担持させ、吸着と分解の 2 つの機能を併せ持った「シリカゲル光触媒」の開発を行った。また、シリカゲル光触媒の基礎特性の解明や、ウエス入れ容器に接続することを想定した循環式分解実験による性能評価を行ったので、併せて報告する。