Male Questioner
What kind of powders does you...?

Li-Ming Lo
Lactose [ph].

Male Questioner
[Unclear].

Li-Ming Lo
Yeah lactose. [Multiple Speakers] like a milk powder, [Unclear] because they will be safe to be use inside.

Female Questioner
If you're not [Unclear]...

Li-Ming Lo
I actually tried to use some nano material but in that case I have to prepare some proposal. I was told I needed...

Female Questioner
Institutional reasons.

Li-Ming Lo
Yeah like [Unclear] I'm their test subject that will be the case.

Male Questioner
Did they specify the size of this machine that's size of the particles?

Li-Ming Lo
I actually [Unclear] all the powders I mentioned I already specified that the size I want, of course yes I would do some test to see the size of [Unclear] the test powder.

Male Questioner
[Unclear] some micrometer or centimeter.

Li-Ming Lo
Of course. Yeah probably just some micrometer.

Female Participant
Micrometer.

Male Questioner
Is this specified in the standard, the size?

Li-Ming Lo
They don't really specify the size. They don't really specify the size.

Male Questioner
Just substance?

Li-Ming Lo
Yeah just substances, not specify the size.

Male Questioner
You pick [Unclear] application?

Li-Ming Lo
I picked the 5 micron it's a big amount okay, [Unclear] will be a little bit challenging for me in the future so they're two different sizes I pick for test to do in [Unclear] it is a powder [ph] test.

Female Questioner
[Unclear] 3 right?

Li-Ming Lo
Yeah.

Male Participant
In fact 4 nanoparticles perhaps it will be followed flow stream much better and larger particle you can assume they just follow the flow stream line instead of doing the test for nanoparticle themselves and we – as [Unclear] we do have some direct reading instruments for particle characterization such as reading concentration, reading the [Unclear] fusion.

Li-Ming Lo
Or the mesh concentration they're lot different.

Male Participant
Right from nanometer to micrometer and also the sampler to take sample for microscope so we have all sorts of these instruments. We'll show you in the laboratory.

Male Questioner
Thank you.

Li-Ming Lo
Thank you.

Male Questioner

You say mobile [Unclear].

Li-Ming Lo
[Multiple Speakers] mobilize it they can be moved to any location you want. That would be more attractive to be using.

James Bennett
Pull the picture again you showed the casters?

Li-Ming Lo
Yeah. I actually put a caster outside. Yeah I – yeah.

James Bennett
How much does it weigh?

Li-Ming Lo
2000 pounds, yeah.

James Bennett
It's got three casters on each side?

Li-Ming Lo
Yeah.

Female Questioner
Wheels

Li-Ming Lo
Yeah. Right. Two casters [Unclear] side bar over there. I can move any it's like where I want and use it [Unclear] like move like measured by the [Unclear] all I need is just repress the exhauster fan I mean larger enough to handle that stuff right here, all I need is to press the one. Yeah. Then – I mean when I mentioned this idea to the research partner who [Unclear] evaluation for us they very interested and say, oh brilliant they can move around and they can be used to different task and I am happy to just [Unclear] to use the [Unclear] all I needed to just collect data. They are very happy. Okay let's do that, you can move it to here so I'm just trying to walk out there in the future to do this, I feel ecstatic.

Male Questioner
That's interesting. What do you mean that, this one what?

Li-Ming Lo
Yes, they will be just electoral coverings [Unclear].

Male Questioner
Power supply.

Li-Ming Lo
Yeah. Okay.

Male Questioner
[Unclear]?

Male Questioner
Sorry, okay.

Male Questioner
[Unclear].

Female Questioner
I didn't know that either.

James Bennett
How uniform is the flow across the ceiling supply?

Li-Ming Lo
We actually did some called a factory test. They're pretty uniformed because they used a smoker and they're very uniformed and very effective to remove air content, all the [Unclear] so I have to mention there's an [Unclear] inside, why should you put [Unclear] or some worker to do that.

James Bennett
[Unclear] space.

Li-Ming Lo
Yes, they're totally different.

James Bennett
How do you achieve that uniform velocity distribution across the ceiling when you have the duct – individual ducts coming in.

Li-Ming Lo
Yeah they can be adjust, the fans base can be adjust so I can adjust any [Unclear] they can be [Unclear] in all of them.

James Bennett
Alright. So to create the uniform velocity you might have different duct velocities

feeding these individual panels, okay interesting.

Li-Ming Lo
Because I also think...

Female Questioner
[Unclear] flowing through heavy [ph] filters right?

Li-Ming Lo
Yeah heavy filter.

Female Questioner
That helps to spread out the airflow.

Li-Ming Lo
I also – just think about I did not test yet. Maybe some called the hot spot I can't provide a more airflow. Yeah I just, I don't want – maybe I sometimes for some case I don't want to provide a uniform.

James Bennett
Right [Unclear] setting in the space it sort of [Multiple Speakers]

Li-Ming Lo
I try to, okay, that's why my request I want to make an effort at adjustment. I wanted to make a [Unclear] for some hot spot and I want to provide more air in [Unclear] worker because our job is protect worker but at some [Unclear] why not protect it further. So there is a trail of, do you want to put [Unclear] product? I want to put [Unclear] worker so I have to develop engine control to convince the owner, hey you can use this engine control to [Unclear] put the workers and your material any of your product then maybe...

Male Questioner
[Unclear].

Li-Ming Lo
Yeah the [Unclear] is treasure.

Female Questioner
Who would actually be operating or making those decision, will there be somebody like you on staff at the company that could make the adjustment?

Li-Ming Lo
I actually try to develop some standard operation as [Unclear] so for some case you wanted to make a different airflow, how do you do that? I just wanted to develop a kind of...

Female Questioner
Yeah standard operating produce, yeah because it might be, I mean I even think or [Unclear] for engineering [Unclear].

Male Questioner
[Unclear] computer interface [Unclear].

Li-Ming Lo
Yes.

Male Questioner
Right. Right.

James Bennett
You can do it from your office. [Unclear] in the field and you can just...

Li-Ming Lo
All I need [Unclear] inside of [Unclear]

[Multiple Speakers]

Male Questioner
Yeah the internet [Unclear].

Li-Ming Lo
Some interest in [Unclear] coming out [Unclear] Bruce.

Male Questioner
You don't have the leakage under the [Unclear] you don't [Unclear]

Li-Ming Lo
Actually I just ordered [Unclear] is a friend even not I can make adjustment because – actually a week [Unclear] the operator under a [Unclear] pressure so I don't really care they touch the [Unclear] or not. You got [Unclear] coming into the government post to get the [Unclear]. Yeah so that would not be the issue for this case.

Male Questioner
Okay. Not big issue. Okay thank you.

Li-Ming Lo
Thank you.

[Multiple Speakers]

Barbara Alexander
This is fine, this works.

[Multiple Speakers]

Barbara Alexander
I'm pulling it backwards that's fine. Here we go now its working.

Male Questioner
[Unclear]

Barbara Alexander
Alright where's my [Unclear]. No [Unclear].

Male Participant
Hey Barbara don't forget your smart card.

Barbara Alexander
Yes my smart card, I'm like go out to lunch I need to be able to come back in.

Male Participant
Otherwise [Unclear] you will be in the office tomorrow.

Barbara Alexander
Yeah, no really do I have it it's just not on me.

Male Participant
Yeah you need that to stay smart.

Barbara Alexander
Yeah. So up until now we've been talking about ventilation for fixed facility. Now...

Male Participant.
Open air.

Barbara Alexander
... we're working on a control that is mobile and can be taken into the field where they're doing oil and gas extraction. Hydraulic fracturing is becoming very widespread in the United States. I don't know if you have this in Japan they call this fracking where they can release oil and gas from tight rock formations.

Male Questioner
We have refinery for oil and gasses the company Exxon companies from US so we have – also we have the few like that.

Barbara Alexander
Okay agreed. So you're somewhat familiar with this? The NIOSH researchers have gone into the field and measured the exposure of the workers and one of the biggest problems that they have found is exposure to the dust from all the sand that is used in hydraulic fracturing so the second vehicle here from the right is a sand mover and these are all sand delivery trucks that are parked next to the sand mover and they use air to transfer the sand from the delivery trucks to this sand mover. You can see the clouds of dust.

Male Questioner
Sand mover of trucks?

Barbara Alexander
Yeah. They bring the sand to the location in a delivery truck like this and then they transfer it from the delivery truck to the sand mover vehicle and this will stay there while they're doing the fracturing and these trucks will come and go.

Male Questioner
Can you explain the fracturing process how the sand is use in the construction?

Barbara Alexander
Yeah well I think if you're familiar with hydraulic fracturing they drill – they can drill horizontally underground.

Male Questioner
It's for the – how to say...

Male Questioner
Extraction?

Male Questioner
Extraction the oil from the undergo [Unclear]. We have [Japanese] we don't have the extraction oil from underground. We don't have oil well.

Barbara Alexander
Oil wells in Japan.

Male Questioner
Maybe we don't have it.

Barbara Alexander
Or natural gas lines.

Male Questioner
Very small country you know.

Barbara Alexander
Yeah.

James Bennett
[Unclear] businessman applying to [Unclear]. US has [Multiple Speakers]

Barbara Alexander
I think it's expanding to other countries but I'm not sure exactly where maybe in the Southeast Asia I'm not sure. But the process depends on all of this sand to keep the cracks open so they use explosive charges to open cracks in the rock and then the sand enters these cracks and keeps them from closing up when the pressure is relieved. So they can extract oil and gas from the rock formation like creating these cracks and the sand is used to keep the cracks open.

James Bennett
Does the oil falls through the sand?

Barbara Alexander
Yeah so there'll be sort of a low concentration of sand in the crack so that the gas and oil can flow out.

James Bennett
How does the sand keep the crack open if it's not really packed in there?

Barbara Alexander
Yeah if you think about – yeah. It depends on the shape of the crack.

Male Questioner
They call it [Unclear] cracks it open.

James Bennett
Okay is it [Unclear] sand?

Barbara Alexander
Just like you might, if you hear – like a tent that you're holding up you might just have some poles holding your tent up but the majority of the tent is open space.

James Bennett
I see and how big are these cracks [Unclear]?

Barbara Alexander
Yes it must be about the size of a grain of sand. So they might be longer, wider, but the height is only about the height of grain of sand.

Male Questioner
They drill and correct me if I'm wrong, they drill and they go off horizontally and the self-explosive [Unclear] that opens the cracks and then using water and chemicals mixed with the sand will force the sand into high pressure, the extracted drill enforce the [Unclear] and force its way into those cracks and it gets stuck there but grain of sand [Unclear].

James Bennett
Is it – the pressure pulls is over and then the oil flows back.

Barbara Alexander
Right.

Male Questioner
It's the ultimate massive pressure in the earth's weight on top [Unclear]. It's a gas. It's a gas [Unclear].

Barbara Alexander
What they put down into the cracks is 95% water – 90 to 95% water about 5% sand maybe 1% - less than 1% of certain chemicals that are used for lubrication and to prevent corrosion of the equipment and so forth. The quantities of water used are quite huge also. Huge quantities of water, huge quantities of sand.

The hydraulic fracturing has become extremely popular in the US especially in the last 10 years and hundreds of thousands of pounds of sand are used to

crack open cracks in the shale and the sand often contains a large amount of silica. There are other things that can be use but the sand is very available, it's very inexpensive but if you inhale respirable crystalline silica it can cause serious health problems including silicosis, bronchitis, emphysema, and lung cancer.

NIOSH researchers were the first to systematically evaluate the occupational exposures to the workers at these hydraulic fracturing sites. Personal breathing zone air samples were collected for workers at 11 different sites around the country in 2010 and 2011 and the silica exposures for sand mover operators were sometimes over 10 times higher than the occupational exposure limits.

There were several major sources where dust was generated and released, those included the thief hatches on top of the sand movers and I'll show you what those look like in a minute. Also uncapped side fill ports so the ports that these sand delivery trucks connect to, if these were not capped when they're not in use those were sources of dust generation. Vehicle traffic on the roads, a lot of the roads lead into these sites is not paved and dust comes up from the road. The transfer belts under the sand movers, also where the sand drops or mixes in belt blender areas that generate dusts. Transfer belts from the sand movers to the blenders and at the end of the sand mover conveyor belt.

This is the picture showing the top of the sand mover. This is a worker at work, he's watching the flow of the sand coming out of the sand mover and these two places on the left where the arrows are pointing these were the thief hatches. Thief hatch refers to the fact that you can collect a sample you can take a sample out of the hatch. Sometimes they want to look down into these hatches to see where the level of sand is inside the sand mover but you can see that there's dust coming out and the worker standing there is being exposed to the dust from the sand.

We are – control is called the mini-baghouse and we tested our mini-baghouse control at company that produces sand for fracking. SWNSand in Arkansas. There are eight hatches on top of this sand mover and we have one bag filter on top of each hatch. You can see at this point all four; these are four different compartments inside the sand mover that can be filled. All four compartments were being filled at this time and you can tell that they're using air to blow the sand into the compartments and the air is coming out of the hatch. So it inflated these bags on top of the hatches.

Male Questioner
Excuse me, so you just keep the baghouse to keep collected the dust?

Barbara Alexander
Right. The dust is accumulating...

Male Questioner
Do you clean the filter?

Barbara Alexander
Yes you have to stop the airflow from time to time and then the dust will fall back into the compartment.

Male Questioner
It means you stop all the flow?

Barbara Alexander
Stop the airflow, yes.

Male Questioner
Just part of compartment?

Barbara Alexander
Yeah you can do it one compartment at a time.

Male Questioner
Okay, stop.

Male Questioner
Mostly exposure occur when they're filling the sand truck from – the sand mover from the delivery trucks and [Unclear] so this one [Unclear] application to other industries you have like maybe [Unclear] where they use pneumatic conveyors to move cement from...

Male Questioner
Cement plants.

Male Questioner
...yeah, yeah any place using pneumatic conveyor this might have a [Unclear].

Barbara Alexander
Yeah, yeah. The worker who is operating the sand mover would be standing at one end of the sand mover and there would be a lot of dust created when they're filling this sand mover.

This is the diagram. Looking down from the top so this shows the sand mover had eight hatches on top and we had one bag on top of each hatch. During our test of the mini-baghouse we collected samples at 12 different locations. These are six numbered locations on top of the sand movers so 1, 2, 3, 4, 5, and 6. They were collecting samples at those spots and also six places on the ground that were identified with a letter A, B, C, D, E, and F. Actually when we looked at our results we did not see very much dust at the ground level where these letters locations were. Most of the dust was on top of the sand mover. There was a lot collected at number 4 and 5 and 6. I think the wind direction it was blowing from this direction during most of the trials so there wasn't much collected at the back of the sand mover.

This is the system we use to collect the respirable dust and respirable crystalline silica. We have cyclone so that we were only collecting the respirable particles on the filter paper. The reductions that we measured in the concentration of respirable of crystalline silica range from 79% to 99% when using the min-baghouse. This is results for the numbered locations on top of the sand mover so this was with the control off, control on at number 1 location; this is number 2 with control off, control on; number 3 control off, control on; this was number 4 you can see there was a lot of dust without the control and it was very low with the control on, same thing at location 5 there was significantly more dust at location 5 without the control and at location 6.

James Bennett
Maybe this first several occasions samples up wind?

Barbara Alexander
Right it was up wind so you weren't seeing anything even without the control. This was an example of the dust that was collected inside the filter bag. It was micron size and I think this is by number – the percent by number so a lot of it was in the 1 to 2 micron size range. This was all respirable from 4 microns and smaller that's all respirable dust that was collected by the filter bag.

Male Questioner
How do they become those particles [Unclear]?

Barbara Alexander
It was x-ray to fraction technique. Yeah.

Male Questioner
Okay. You mean the few samples [Unclear].

Barbara Alexander
Yeah that was dust that came out of the bag, dust that we had stopped by using the bag.

Male Questioner
You take a piece of a cloth and then sent for analysis?

Barbara Alexander
No, actually it was sort of a fortuitous sample the bags from a leak and they collected the dust that leaked from the bag and analyze the size of the dust.

Male Questioner
You mean micron size what is micron size, under 1000 microns your mean? [Unclear]?

Barbara Alexander
Yes 5 under 10.

Male Questioner

Under 10 microns.

Barbara Alexander
Yes. So here is the size greater than 20 micron – 10 to 20 micron, 5 to less than 10.

Male Questioner
Oh I see it's just hard to [Unclear] distribution is it?

Barbara Alexander
Yes size distribution of the dust that we collected...

Male Questioner
I couldn't see that.

Barbara Alexander
... with the bag, yeah so it's small. This is photomicrograph of the dust collected by the mini-baghouse. It was 64% crystalline silica quartz. You can see some of the particles around it and some have sharp edges. There was some concern that the sharp edges might be because the particles were freshly fractured and the freshly fractured silica is even more hazardous to inhale beyond the aged silica.

We have modified the design of the mini-baghouse. The earlier one had only a single bag that was about 11 inches in diameter. We're going to go back and try the design that is four smaller bags mounted on each thief hatch. The smaller bags will give us more surface area so it should be better for the airflow. It should be less stress on the bag. It should be easier to clean the bag.

We also have a Teflon coating on the inside of the bag so it should release the dust better when the flow stops. The old style they had to shake the bags to get the dust fall out on the bags but that should be slipperier in the inside.

We plan to rest the redesigned baghouse in the spring. We'll go back to Southwestern Energy in Littlerock Arkansas and test our design there. That's all I have in the presentation, very short. That's just something that we're working on to help protect the workers on hydraulic fracturing sites.

Female Questioner
Good. I mentioned at my presentation that [Unclear] the patented technology so [Multiple Speakers].

Barbara Alexander
Yeah so we took out a patent on the original version of this technology and there's a producer of business who has licensed the patent so they want to produce this to use in the field, yeah.

Female Questioner
Excellent, [Unclear] accomplished for [Unclear] years.

Barbara Alexander
Yeah that happened before I got here so I can't take a name credit.

James Bennett
Do you think there are – sand is used in other [Unclear] processes like [Unclear] foundry but I think you got other mobile processes, any ideas about using this baghouse – this mini-baghouse concept for other thrill like road construction equipment?

Barbara Alexander
We haven't thought about it but that's a possibility.

Male Questioner
But they do know [Unclear] like the foundry to delivery by truck and fill of silo, [Unclear] silo that's an air pollution concern, this is going to be [Unclear].

James Bennett
Right. Right, okay.

Barbara Alexander
Yeah.

Male Questioner
How – I mean you mentioned that use the baghouse filters to collect the dust, how about – did you have any [Unclear] for the dust [Unclear] is that dry or a little bit moist?

Barbara Alexander
It's dry.

Male Questioner
It's dry.

Barbara Alexander
Yes.

Male Participant
Most of the [Unclear].

Barbara Alexander
They mix it with water in a blender before they put it into the well.

Male Questioner
Okay.

James Bennett
That's very specific sand right, this is from different parts of [Unclear]?

Barbara Alexander
Yeah and it has to have certain size, it has to have a certain roundness, and yeah. But I think they do get it from different locations whatever is a good location for their look well so in Texas they're probably getting their sand from Texas or Oklahoma, in North Dakota they're probably getting their sand from, yeah closer by.

Male Questioner
[Unclear].

James Bennett
There was lots of sand in the southeast [Unclear].

Barbara Alexander
Yeah no fracking in the southeast so I think it's...

Male Questioner
[Unclear].

Barbara Alexander
Well I would consider it central maybe [Unclear] but...

Male Questioner
[Unclear] confederacy.

James Bennett
I'm sure it's best.

Male Questioner
It's the south.

James Bennett
It's part of the SCC conference right.

Barbara Alexander
That means nothing, right. The big 10.

James Bennett
That's true not anymore yeah.

Barbara Alexander
Big 12. The pack 12 yeah but...

Male Questioner
In this industry [Unclear] off the sand price?

Barbara Alexander
I wouldn't expect that it has but you know [Unclear].

Male Questioner
There is also concerns about pollution around the quarries because a lot more activity so the neighbors of the quarries were concerned.

Male Questioner
I had the interruption with [Unclear] and the [Unclear] pull out using sand in their product not necessarily because of the [Unclear] because of the price, the price has been amazing.

Female Questioner
It's really interesting.

Barbara Alexander
That could be because of the fracking [Unclear].

Male Questioner
But now oil prices are bottoming up.

Male Questioner
Right.

James Bennett
[Unclear] the worse or...

Male Questioner
[Unclear].

Barbara Alexander
Natural gas is still – natural gas price has some falling as fast so they're still fracking for natural gas, yeah.

James Bennett
What's a notable chemical exposure hazard [Unclear]?

Barbara Alexander
Yeah I think there are some benzene exposure for certain job classifications.

Male Questioner
Is that from the return of the product from the ground [Unclear]?

Barbara Alexander
Yeah they have this [Unclear] tanks where they need to do tank gauging so they need to open the hatches on top of the tanks to see how high the liquid level is people who are doing that tank gauging are exposed to some benzene notably levels, occupational exposure limits for benzene are pretty low and yeah.

James Bennett
It seems like there could be a way that to get that information without opening those tank.

Barbara Alexander
Exactly. Exactly but that's the state of the art thanks to...

Male Questioner
[Unclear] measuring tank.

James Bennett
Something that we can [Unclear].

Barbara Alexander
Yeah. Great.

Male Questioner
I remember an article about some companies using different solvent – maybe not solvent, different chemical is that water to replace water for extraction – tracking oil and gas that maybe [Unclear].

Male Questioner
There's a fact that [Unclear].

James Bennett
Okay.

Barbara Alexander
I would think that it would be more expensive [Unclear] [Multiple Speakers]

Male Questioner
Sometime maybe the water is an issue [Unclear] water?

Barbara Alexander
Yeah a lot of the places where there...

Male Questioner
[Unclear] comes up its radioactive, it strong.

James Bennett
It's radioactive [Unclear].

Male Questioner
Remember news a few years ago about explosion [Unclear] site caused chemical [Unclear].

Male Questioner
The diesel I think [Unclear].

Barbara Alexander
Diesel [Unclear] is another exposure that they're [Unclear]. Great.

Male Questioner
How do you detect the [Unclear] silica for example?

Barbara Alexander
Yes, the filter papers are weighed for the total respirable dust and then they use x-ray diffraction to determine crystalline silica on the paper.

Male Questioner
[Unclear]

Barbara Alexander
X-ray diffraction.

Male Questioner
Yeah [Unclear] microscope.

Male Questioner
X-ray diffraction.

Barbara Alexander
Yeah.

Male Questioner
X-ray?

Barbara Alexander
XRD.

Male Questioner
XRD.

Barbara Alexander
Yes.

Male Questioner
They have to dissolve the filter and then redeposit the silica under silver filter and then put in x-ray diffraction apparatus [Unclear].

Barbara Alexander
Only the crystalline silica is the dangerous one, amorphous silica is not dangerous to inhale but the crystalline silica is. You can see the crystal will diffract the x-rays and the amorphous material will not.

Male Questioner
They use the [Unclear].

Barbara Alexander
Right.

Male Questioner
[Unclear] has detailed matter.

Male Questioner
Yeah that's standard method.

Barbara Alexander
Yes standard.

[Multiple Speakers]

Male Questioner
At 7500 is the x-ray diffraction for silica?

Barbara Alexander
Yeah, NIOSH manual of analytical method, the method 7500.

Male Questioner
It's available on [Unclear].

[Multiple Speakers]

Male Questioner
[Unclear] NIOSH [Unclear].

[Multiple Speakers]

Male Questioner
[Unclear] detectible. It's very good.

Male Questioner
It's all English, you know.

Barbara Alexander
I'm sorry it's only in English yes.

Male Questioner
That's easy you can [Unclear] go translate then you do the translate.

Barbara Alexander
Yeah this is it. Yeah.

Male Questioner
The disadvantages it requires re-deposition so you can't to transfer [Unclear].

Barbara Alexander
Yeah.

Male Questioner
That's simple preparation.

Male Questioner
Yeah then how to prepare the sample, how to make a correction and how to analyze [Unclear]. We publish our [Unclear].

Barbara Alexander
X-ray powder diffraction equipped with copper target x-ray to graphite proper disintegration.

Male Questioner
[Unclear] in Japan you should have [Unclear].

Male Questioner
It's almost the same in Japan.

Male Questioner
[Unclear] Japanese [Unclear].

Barbara Alexander
Yeah we probably do. It was Japanese technician who was working on it, right.

Male Questioner
[Unclear].

Male Questioner
[Unclear].

Barbara Alexander
That's [Unclear].

Male Questioner
[Unclear] can't fix it.

Male Questioner
[Unclear].

Barbara Alexander
Yeah.

[Multiple Speakers]

Male Questioner
[Unclear] silica [Unclear] wide he said it.

Barbara Alexander
Right yeah. Yes. Those are the three different types of cores [Unclear]. We find only quartz in the sand that we were using, only quartz.

James Bennett
[Unclear].

Barbara Alexander
Yes, yeah quart is system most prevalent [Unclear].

James Bennett
Silica is the hazard that doesn't go away.

Barbara Alexander
Yeah.

James Bennett
It's thousands of years is where the recognizes.

Male Questioner
Land you're a classic [Unclear] it never go way.

Trudi McCleery
Yeah it's true. So that's [Unclear]. I have one thing to mentioned I didn't mentioned before, off topic and within your handout I put in some flyers on appearing [Unclear] so we were very calm loss [Unclear] prevention program. There is some information about that. If you're wondering about that I could slip that in because part of our – that's my job. We worry about noise control and [Unclear] perfection.

Male Questioner
Yeah that's it different you do.

Trudi McCleery
[Unclear] all of that, 9000 things that we do.

Barbara Alexander
Yeah.

2．シリカゲル光触媒分解装置の装置設計

2.1 反応容器の設計

(1)ジクロロメタン検量線の作成、定量下限値の算出

本実験において、ジクロロメタンの検量線作成に用いた濃度とピーク面積の関係を表2.11に示す。その値をもとに作成した検量線を図2.8、定量下限を表2.12に示す。

表2.11 ジクロロメタン濃度とピーク面積の関係

濃度 ppm	ピーク面積 μV・s
10	2740.9
50	11835.6
100	23324.9
250	65931.4
500	140311.4
750	213852.2

表2.12 ジクロロメタン定量下限値算出結果

回数	ピーク面積 μV・s
1	2792
2	2710
3	2764
4	2774
5	2665
標準偏差	52.23
定量下限濃度 ppm	1.806

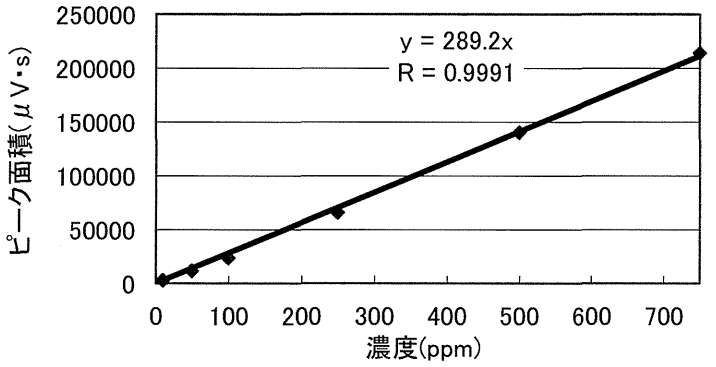


図2.8 ジクロロメタンの検量線

(2)ブランク試験

仕切り板を5枚設置した時の反応容器における容器吸着・漏洩試験の結果を図2.9に示す。また、光触媒吸着試験の結果を図2.10に示す。なお、6種類の反応容器間で光触媒吸着試験の結果に変化がなかったので、仕切り板を設置しない反応容器での実験結果のみを示す。

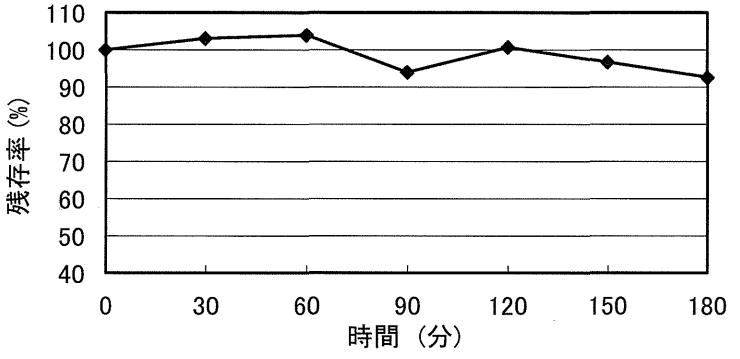


図2.9 ジクロロメタンの容器吸着・漏洩試験

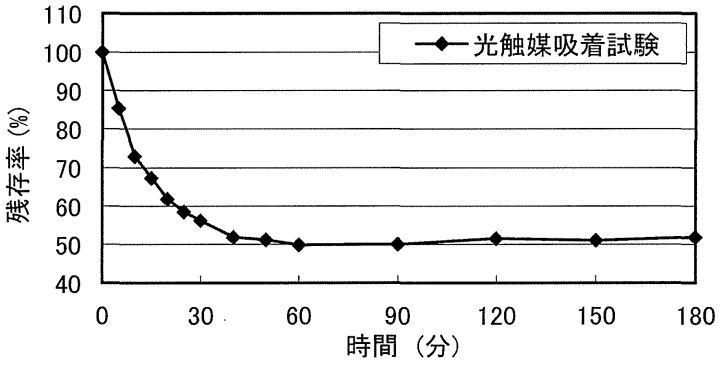


図 2.10　ジクロロメタン吸着試験による残存率変化

(4)分解実験

6 種類の反応容器について、ジクロロメタンの分解実験、完全分解率の結果をそれぞれ図 2.11、図 2.12 に示す。

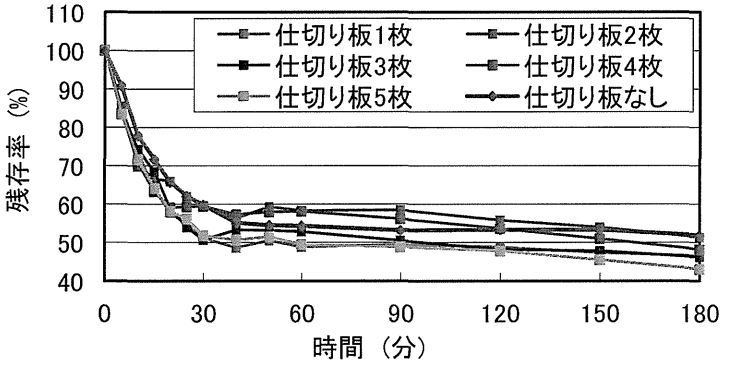


図 2.11　ジクロロメタン分解実験による残存率変化

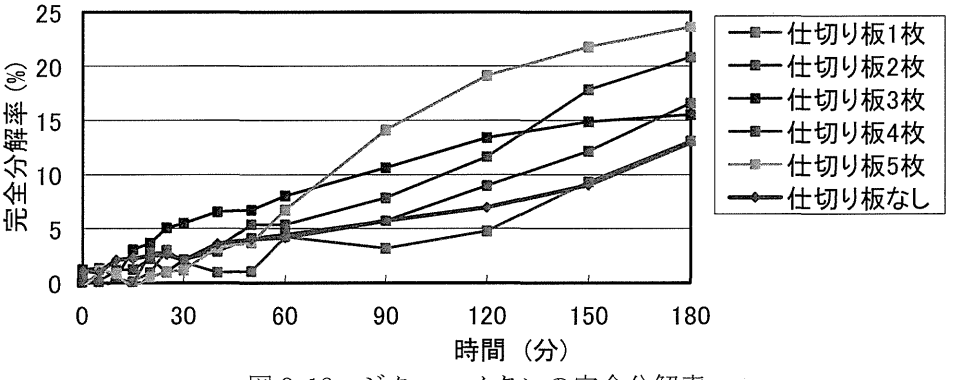


図 2.12　ジクロロメタンの完全分解率

2.2 反応容器の接続方法の検討

(1)ジクロロメタン処理実験

① 検量線の作成、定量下限値の算出

本実験において、ジクロロメタンの検量線作成に用いた濃度とピーク面積の関係を表 2.13 に示す。その値をもとに作成した検量線を図 2.13、定量下限を表 2.14 に示す。

表 2.13 ジクロロメタン濃度とピーク面積の関係

濃度 ppm	ピーク面積 μV・s
10	2338.14
50	11835.6
100	23324.9
250	58646.4
500	120591.6

表 2.14 ジクロロメタン定量下限値算出結果

回数	ピーク面積 μV・s
1	2261
2	2294
3	2414
4	2368
5	2353
標準偏差	2.596
定量下限濃度 ppm	2.533

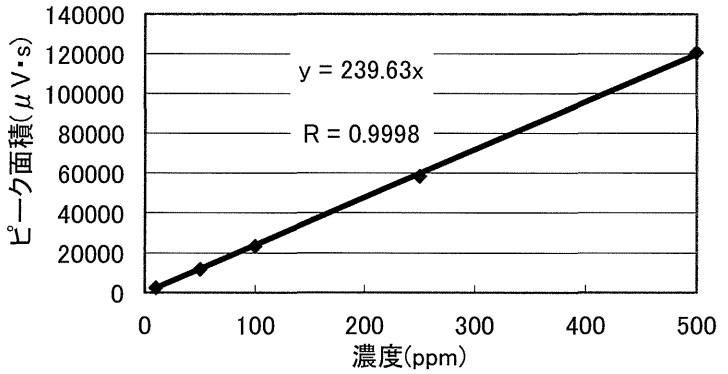
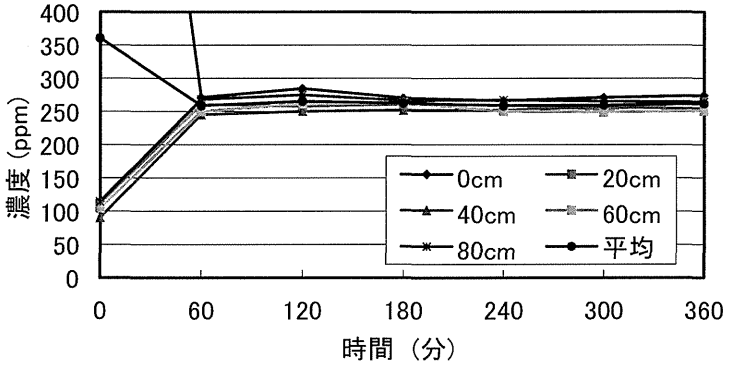


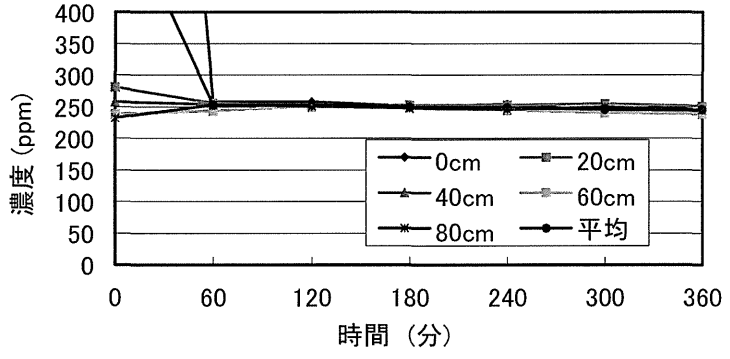
図 2.13 ジクロロメタン検量線

② ブランク試験

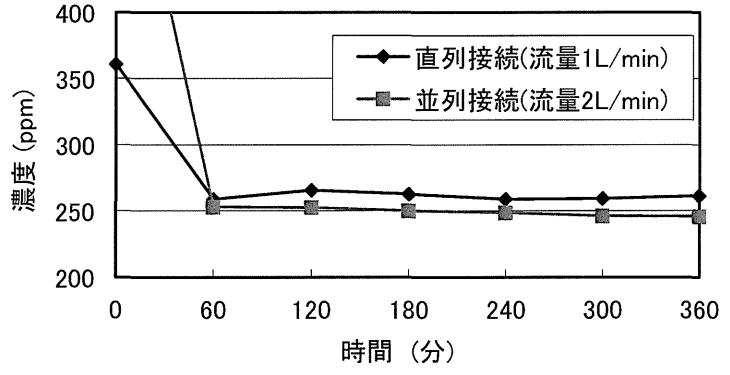
直列接続(流量 1L/min)および並列接続(2L/min)について、ジクロロメタンの容器吸着・漏洩試験結果を図 2.14 に示す。また同様に、ジクロロメタンの光触媒吸着試験の結果を図 2.15 に示す。



(a) 直列接続(流量 1L/min)

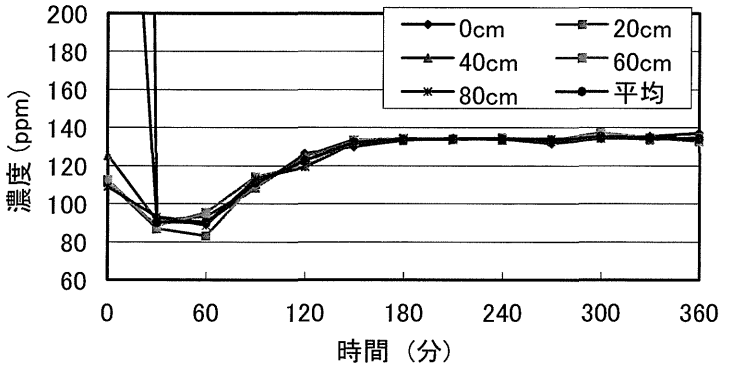


(b) 並列接続(流量 2L/min)

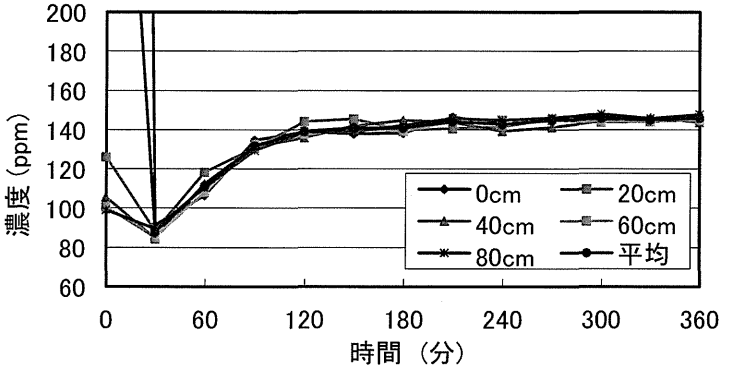


(c) まとめ

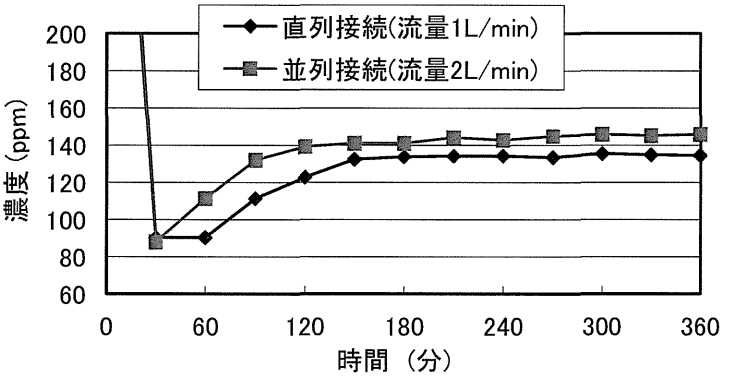
図 2.14 ジクロロメタンの容器吸着・漏洩試験



(a) 直列接続(流量 1L/min)



(b) 並列接続(流量 2L/min)

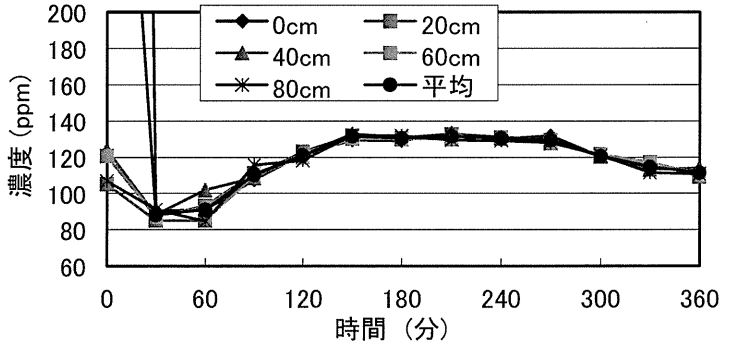


(c) まとめ

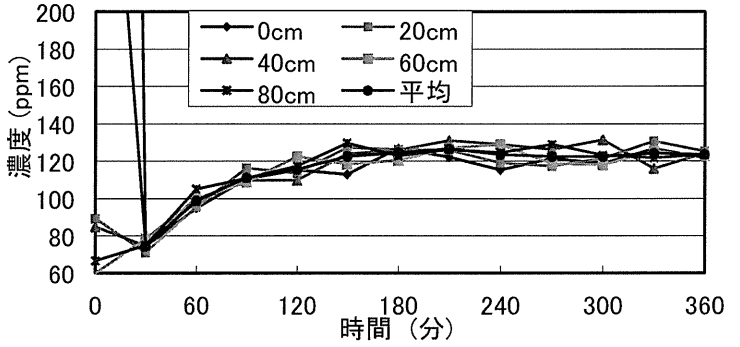
図 2.15　ジクロロメタン吸着試験による濃度変化

③　分解実験

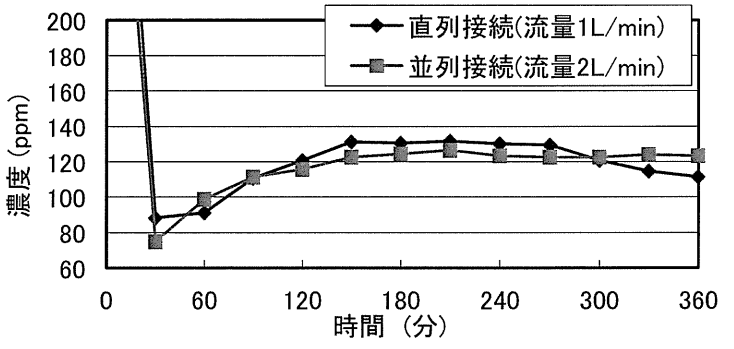
ジクロロメタンの光触媒分解実験、完全分解率の結果をそれぞれ図 2.16、図 2.17 に示す。



(a) 直列接続(流量 1L/min)



(b) 並列接続(流量 2L/min)



(c) まとめ

図 2.16　ジクロロメタンの光触媒分解実験による濃度変化

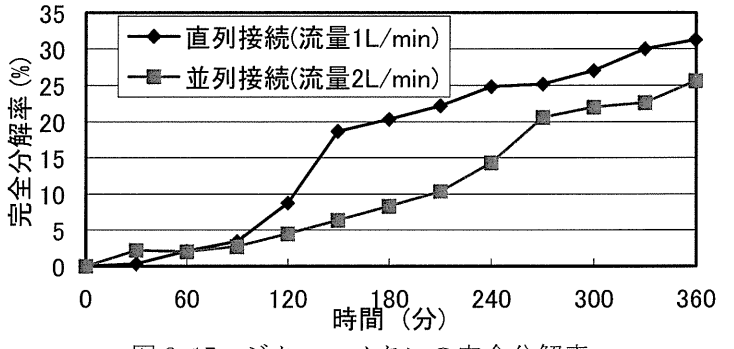


図 2.17　ジクロロメタンの完全分解率

(2) トルエン処理実験

① 検量線の作成、定量下限値の算出

トルエンの検量線作成に用いた濃度とピーク面積の関係を表 2.15 に示す。その値をもとに作成した検量線を図 2.18、定量下限を表 2.16 に示す。

表 2.15 トルエン濃度とピーク面積の関係

濃度 ppm	ピーク面積 μV・s
10	13078.62
50	67946.2
100	133076.7
250	312019
500	643034.2

表 2.16 トルエン定量下限値算出結果

回数	ピーク面積 μV・s
1	13162.4
2	13007.8
3	13021.4
4	13089.2
5	13112.3
標準偏差	64.33
定量下限濃度 ppm	0.5023

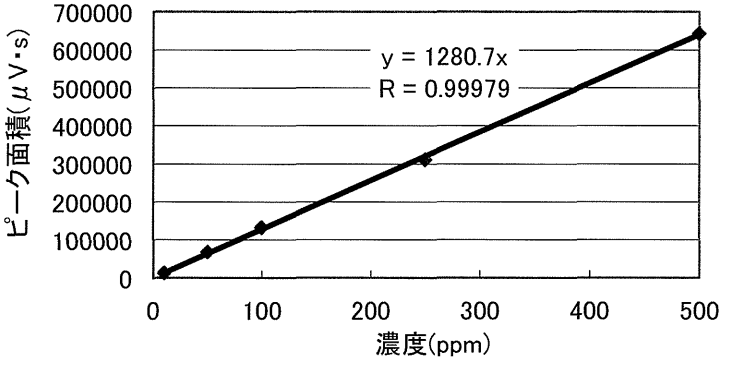
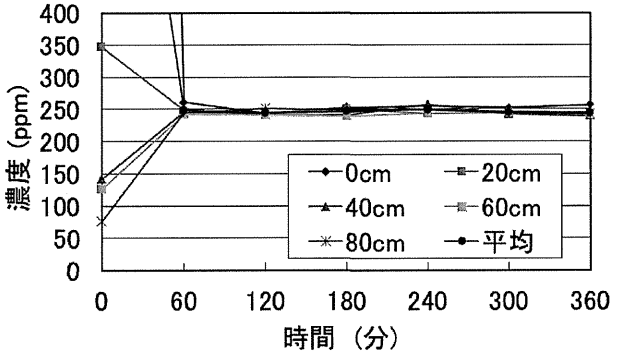


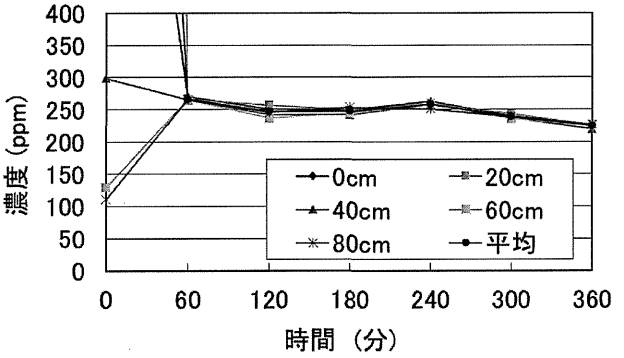
図 2.18 トルエン検量線

② ブランク試験

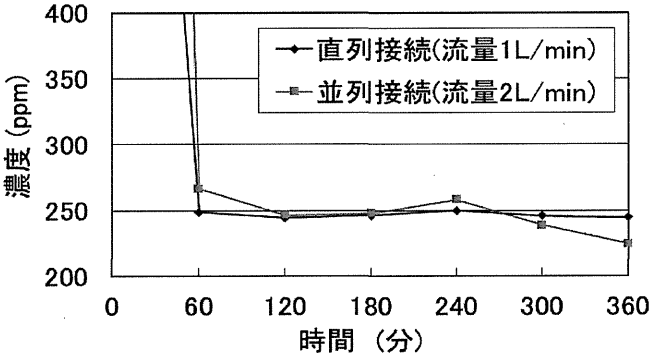
直列接続(流量 1L/min)および並列接続(2L/min)について、容器吸着・漏洩試験の結果をそれぞれ図 2.19 に示す。また同様に、トルエンの光触媒吸着試験の結果を図 2.20 に示す。



(a) 直列接続(流量 1L/min)



(b) 並列接続(流量 2L/min)



(c) まとめ

図 2.19 トルエンの容器吸着・漏洩試験