**00:00:00**

**Wan Zuhairi Wan Yaacob**

Okay. Good afternoon, ladies and gentlemen. It is my pleasure to be here this afternoon and then to share with you some of the - my research and the consultation work in Universiti Kebangsaan Malaysia. Today, I would like to talk about a topic of geo-environmental issues in Malaysia. This is not all the issues that are happening in Malaysia right now. I am just trying to select a few topics that might be interested to share with all of us today.

Before I begin, I will like to send – to say my gratitude to Kagawa National College of Technology for accepting me here in this college. It all – it all happened during our conference in Seoul 2011 and then in this – actually there was a conference in Kagawa in GEE2011 where I supposed to attend that conference in 2011, but because of the natural disaster that struck Fukushima in 2011, I cancelled my flight to attend the GEE2011. But I am very happy because at last I arrived here in Kagawa and then also tried to share with you some the slides of my work in Universiti Kebangsaan Malaysia. So, thank you so much Professor Kotake for very nice introductions and then my name is Wan Zuhairi Wan Yaacob and I am a lecturer from Universiti Kebangsaan Malaysia.

Okay, this is the content of my presentation for today because of the special request by Professor Kotake. I would like to make some introduction to UKM and then after that I will discuss about the environmental law and regulations in Malaysia and then I will talk about several geo-environmental issues in Malaysia, for example, illegal dumping of toxic waste, hydrocarbons contaminated sites, improper closure of landfill, and also abandoned mining land or the phenomena of acid mine drainage. I think President Kamon is familiar with this topic because he has done quite extensive work related to geo-environmental issues, especially in Japan. So probably he can give me lots of comments and then questions about my presentation today.

Okay, first of all, about the introduction to UKM. As Professor Kotake told you just now, my university is Universiti Kebangsaan Malaysia or abbreviated as UKM or you can say National University of Malaysia and then abbreviation is NUM, National University of Malaysia. The university was established on May 18, 1970, okay. So, it is about 43-year-old until this date. And then my university is regarded as the second – and second oldest university in Malaysia. The first one is University of Malaysia that was established in 1949. So, we are the second oldest and then in terms of ranking, we are only second place behind the oldest university of University of Malaysia. So, it’s like Kyoto University in Japan, the second ranked university in Japan. And then overall, UKM has 13 faculties and then we have also one Graduate School of Business Study and also we have 16 research institutes in UKM. And then in terms of research capability of UKM, we are one of the five research universities in Malaysia. So, there are five research universities in Malaysia including Universiti Sains Malaysia, Universiti Malaya, Universiti Putra Malaysia and also Universiti Teknologi Malaysia. So, the advantage of being one of the research university of Malaysia is that the university can get lots of grant from the government compared to the other universities in Malaysia. So, in terms of money, we can get more money to do research compared to the other universities in Malaysia.

**00:05:01**

Okay, I wanted to introduce you to my university. This is – no, I mean faculty. So, this is my faculty, Faculty of Science and Technology. And then it is divided into schools and also below schools you can see many programs, many academic programs. So, there are five schools in my faculty, School of Environmental and Natural Resources Sciences, School of Biosciences and Biotechnology, School of Applied Physics, School of Chemical Sciences and Food Technology, and also School of Mathematics or Mathematical Studies. These are the number of staff in our faculty. P is professor, AP is associate professor, and L is lecturer. In my school, we have about 24 professors, 25 associate professors, and 39 lecturers. In total, we have 71 professors in that faculty only, in that Faculty of Science and Technology.

Okay, if you look at University or Faculty of Engineering, Faculty of Engineering and Built Environment, they have different academia structure compared to Faculty of Science and Technology where you have UKM Faculty and also department. There about five departments in – under Department of Engineering and Built Environment. So, Department of Civil and Structural Engineering, Department of Electrical, Electronic and Systems Engineering, Department of Chemical and Process Engineering, Department of Mechanical and Material Engineering, and also Department of Architecture.

In terms of research, in my university, the research is managed by a research center, okay. There are – there is a center which is called Center for Research and Instrumentation or CRIM. So, CRIM is the one of the well-known institute in our university because the task of this Center is to organize or to administer all the research grants in our university, so it’s very important research center. It was founded in January 1995 and then in order to make UKM as one of the leading research university in Malaysia, we are dividing our expertise into niche. So, we have different niche. We have different expertise. UKM has divided the research capability into eight research niche areas. So that means the rec – the lecturer will be grouped into different field of expertise or we call it niche. So, this is a niche, for example, the research niche and then inside the research niche, you can see or you can find several research clusters, okay. So, this is the research clusters and then inside the research clusters, there are research groups, all right. So you have groups inside the cluster and there are clusters inside the niche.

So, by doing this, UKM can pool all the experts together and then we can try to solve any research which is - need collaborations between different expertise in UKM, yeah. So, that’s why we have groups and we have niche, we have cluster, and also we have a group. So, there are – there are about eight research niche in UKM. Number 1 is Challenges for Nation Buildings, that’s a niche. Regional Sustainable Development, number 2. Number 3 is Renewable Energy. Number 4 is Health Technology and Medicine. Number 5 is Climate Change, this is very important nowadays to see the changes of the climate, and number 6 is Nanotechnology and Advanced Materials. Number 7 is Biodiversity for Biotechnology Development. Number 8 is Content-Based informatics. These are the eight niche in UKM and then I put number 2 and number 6 in different color of red because these are the two niche that are involved in terms of research, okay. If you look at number 6 - number 2, for example, this is a niche number 2, Regional Sustainable Development. In this particular niche, it has 6 clusters and then 17 research groups, right. If I take, for example, one cluster which is Environmental Security and Disaster Management, part of the 6 clusters…

**00:10:01**

There are 4 groups in these clusters, Geodisasters and Environment, Environmental Science and Engineering, Sustainable Health and Life, and also Environmental Health, all right. So, I am deeply involved with research group number 1 which is Geodisasters - Geodisasters and also Geoenvironment.

Another niche that I would like to share is also in my best interest which is niche number 6, Nanotechnology and Advanced Materials. There are 4 clusters in this niche and then there are about 44 research groups in this particular, in these four clusters. So, I take one cluster which is Advanced Materials Engineering and also involve with research group number 9 which is Geotechnical and Geo-Environmental Engineering. So, one lecturer or one scientist can join at least two groups, okay, and then at the end of the year, you have to submit your progress or your progress report to the university, and then based on your performance, the university will give you some money in order to develop your own groups. So every year, all these groups will compete to each other in order to get higher mark, so that they can earn research – more money from the university in order to operate the groups.

In terms of consultation work, this is also very, very important in UKM. So, we have done lots of research and lot of consultation work, especially with the companies outside the universities. So, this the website of the center of consultation agency in UKM and you can see here that it says academic should not shy away from consultant work. So, that means our university promotes a lecturer to do more research work outside the university so that you can apply your research or your knowledge outside the university and then you bring back the knowledge into the students in the classroom. So, you share or you get the – the first-hand information from outside and then bring it to the classroom. So, there are two ways of conducting research or consultation work in UKM, either you can ask the company to give you money in terms of research grant. So, you can make it as a research grant, but the money is come from the company outside the university or you can – sometimes the company approach the UKM Consultation Management Centre and then they get the money, then they will call the expertise based on their database in UKM and then they set up a group and then they will do the research on behalf of the UKM Consultation Management Center. So, there are two ways of conducting consultation work in my university.

Okay, now we go for second topic for today which is Environmental Law and Regulations in Malaysia. So, this might be a bit – it’s not technical, but sometimes you will have to be a lawyer to understand laws and regulations.

Okay, this might be very complicated because this is the framework of the environmental law in Malaysia, okay. In Malaysia, we have quite an old environmental law which was enacted in 1974 which is very old compared to Japan, even Taiwan or even Korea. They have - they have already upgraded their act. So, we are still – Malaysia still depends on the old act which is called Environmental Quality Act 1974 or the act name is Act 127. And then this act is administered or this act is managed by the Department of Environment in Malaysia. And then in terms of the soil and groundwater pollutions which are very important for our discussion today, so there are no specific regulations regarding to soil and groundwater contamination in Malaysia, but lawyer has to find some provisions in this act in order to find something that can be used to sue someone who pollute the ground or something like that. So, based on the Environmental Quality Act 1974, especially in part IV, there is a mention of contamination of soil and groundwater in prohibitions and control of pollutions under section 24 and under section 25. So, they are only mentioned in the act but there is no details in legislation or in the orders of this law, right.

**00:15:04**

So, there are 30 - there are 30 regulations altogether in this act and there are 22 orders in that particular act. So, none is directly related to soil and groundwater in Environmental Quality Act 1974.

So, this is the some introduction to soil and groundwater regulations in Malaysia which is part of the - our main topic today. So, there are no specific legislation addressing soil and groundwater contamination in Malaysia and then we don’t have any soil or groundwater quality standards. Probably we have soil standards, but I am confident that we don’t have groundwater quality standards. And our soil quality is not monitored. We do not regularly monitor the quality of the soil in our country, but we monitor surface water and also now we are monitoring the groundwater, okay. And then contaminated land is slowly gaining importance in Malaysia because of the several cases of the illegal dumping of toxic waste in Malaysia. And then in terms of soil remediation regulations in Asia, I will say that Taiwan, Korea, and Japan are the countries that have a very good set of regulations in terms of soil and groundwater in – in these regions.

This is a com - comparison between different countries in Asia and also what they have. You can see that these countries – this is the Soil Remediation Law, this is the Environmental Law, the guidelines that have been published by the - certain agencies in that particular states or countries, and then soil environmental standards. So, if you see Japan and Taiwan have a full sets of good governance, sets - full sets of soil remediation law and then legislations. They have soil rem - soil remediation-related law, they have environmental law in terms of wastes and etcetera, they have guidelines and also they have standards. And then if you see Korea, they still don’t have guidelines. And then Malaysia, Hong Kong, Singapore, we still don’t have soil remediation-related law.

If you look at the cluster of different states, Thailand, Indonesia, Philippines, even India and also Vietnam, they also don’t have soil remediation related law, practical guidelines and also standards, but they do have the environmental law in general. China, it is based on the regions. For Beijing, they do have soil remediation related law. But in Pakistan, it seems that they don’t care about the environment because they don’t have anything in their country. Okay, this is all the comparisons of law in different states especially – different countries especially on soil and groundwater remediation regulations. So, you can see Taiwan probably I would say has good sets of laws and regulations regarding to soil and groundwater contaminations. Japan also has a good water pollution control law where inside that you can groundwater mentioned four times in this particular law. You also have – Japan also has Soil Contamination Countermeasures Act which is very specific to soil. And also Korea, one act for soil, one other act - another act for groundwater. And unfortunately in Malaysia, we still don’t have the specific regulations, acts that is specific for soil and groundwater contamination. Probably in the future, probably the government is still in a process of drafting new regulations and then – in order to promote better lifestyle in – in – in Malaysia.

So, in terms of geo-environmental issues that I would like to talk in this afternoon, actually I will concentrate more on contaminated land in Malaysia or polluted land in Malaysia. I will talk about illegal dumping of toxic waste in Malaysia. There is one case which is regarded as the worst case of illegal dumping of toxic waste in Malaysia. I will talk about hydrocarbons contaminated site in Malaysia, improper closure of landfill, and also abandoned mining land in several states in Malaysia.

**00:20:01**

Okay, this is the introduction to illegal dumping of Malaysia. I have old data from 2002 to 2006. There were about 107 cases of illegal dumping of toxic waste in Malaysia and then most of these cases occurred in Selangor because the Selangor is regarded as the most developed state in Malaysia. So, this is the location of Selangor and then it is the most developed state in Selang – in Malaysia. There are many factories in Selangor and the Selangor is the richest state in Malaysia. Then they also have so many problems with the illegal dumping of toxic waste. But the worst case of dumping of toxic waste was occurred in 2006 in a place located in Felda Bukit Gatom in Johor which is located on the southern part of Peninsular Malaysia.

Okay, this is the problem of illegal toxic waste in Malaysia where this accident occurred in 7th January 2006 and then the site had a problem with the illegal dumping of aluminum - aluminum dross whereby when the aluminum dross will come – exposed to the air or exposed to the water, it will produce the vapor or ammonia vapor which is very dangerous to people, okay. So, this is the worst case. There was no death, but about 00,000 or 1000 villages and 5 schools with 3000 pupils affected due to the ammonia vapor. So, this is the contaminated material of aluminum dross, this is part of it, and then when - when it is exposed to air or water, it will produce what we call ammonia vapor and then it will – it will make some people sick with this kind of gas.

Okay, so it took about 3 weeks in order to government to clear up the site and then the cost for disposal of this illegal dumping is about 3.17 million. And then the government has to pay using the National Disaster Fund because the government could not locate or could not detect who was the main culprit behind this illegal waste disposal there. And then for disposing this type of chemicals, they have to send it to the Bukit Nanas Waste Management Centre which is located about 200 kilometers from the site. So, they have to bring the waste to that particular site in order to get it disposed. This is the site after remediations, and then what comes after this accident is a tight regulation by the Department of Environment. Immediately after these accidents, the DOE has established one division which is called Hazardous Substance Division. And then the task of this division is to produce what we call a framework for managing contaminated sites in Malaysia. So, after the accidents, this division has been setup and then their mega task is to look at the guidelines of how to manage or how to properly manage the contaminated sites in Malaysia.

So, they come up with three sets of guidelines in order to manage our contaminated land properly. So, they call it Contaminated Land Management and Control Guidelines number 1, number 2, and also number 3. So, number 1 is related to site screening levels, what are the standards for the site can be considered as polluted or not, that’s site screening levels and then how to assess and how to reporting contaminated sites can be obtained in number 2. And also how to remediate the site is presented in management or in Contaminated Land Management and Control Guidelines Number 3. So this is the sets of guidelines that are present in Malaysia at the moment and then hopefully these guidelines can be turned into legislations. So, when it turns into legislation, when it turns into law, then every company has to follow these guidelines in order to remediate the polluted sites in the area.

**00:24:58**

A part of the guidelines that were published by the Department of Environment, there is also standards that published by the other organization such as by SIRIM Berhad. SIRIM Berhad is the Malaysian owned company and then the task of SIRIM is only to generate standards for Malaysia and then they already look at all the standards and then they publish two standards regarding to contaminated land in Malaysia. The first standard or guidelines that have been – that has been published by SIRIM is Guidelines for Developing and Implementing Early Action for Site Remediations and then the second one is Practice for Assessment of Attaining Clean Up Level for Site Closure.

Okay, this is the response by the company in Malaysia, okay. So, certain companies in Malaysia, especially the big players in energy on – in other city, they try to utilize the guidelines and then they try to follow the guidelines before they got a problem with the DOE. This is some of the photos the project that I involved with, especially in the remediation of the hydrocarbons contaminated sites in several states in Malaysia. The first site was already completed in terms of investigation and also in terms of remediation. It is located in Gong Badak in Terengganu in Malaysia and also - we also got another two projects in Inanam, Sabah. They have a problem with the contaminated sites with these kind of oil or naphthalenes and also another one is in Penampang, Sabah which is also located in Sabah. And then they will probably hire us in order to do more research in Labuan and also in Lahad Datu in the future.

So this is part of the response by the big companies in Malaysia because they want to make sure that they don’t have a problem with the new guidelines that were published by the Department of Environment. This is the site conditions in our first project in Gong Badak which is here and then you can see that the site is really contaminated with oil. This is part of the – the sites and then you see the black stains here. So, that represents the – the – the contaminated oil or the polluted oil. And then we have collected some samples and then we checked the concentration of several mediums or environmental mediums. For example, for surface soil, the concentration is about 27,000 to 35,000 milligram per kilogram of this soil. And then we also collected subsurface soil with the concentration less than 1 milligram per kilogram that means there is no pollution into the soil under the ground. And then the subsurface water is about 0.04 milligram per liter and also the surface water is also very low, it’s about 0.04 milligram per liter.

So, this is the investigation that – that were carried out in these sites. We drilled a few holes in order to get some samples under the ground. This is part of the samples that was collected and tested for hydrocarbons which is very, very low. And then you can see a thin films of oil on the surface of the drains on this particular site. We sampled this water as well and then we built what we call monitoring well, so that we can come here and collect water samples and then get it analyzed. And we also get some air samples to get some – or to get the information of the gas that probably produce by this kind of oil in that particular sites.

In terms of remediations, the remediation work was carried out by the company, but we recommended a few options for them to do remediations. So, normally they excavate the sands that was polluted and then put it in these drums and they wash it using – using water and then they produce a very thick films of oil, okay, on top of the water. So this is oil that was produced by this washing and separation technique. And then the clean soil that – the clean soil was returned back to the site and used to cover this excavated part of the sites. And then the concentration after the treatment is a bit high, which is about 2900 to 6000 milligram per kilogram, although the percentage of removal is very, very high, it’s about 83-point – 83% to 89% of removal of oil.

**00:30:04**

And then the sand was returned back to the site and then the site was covered with concrete and also with dirt in order to prevent this contaminated soil to pollute the environment in the future.

Okay, the next project that I would like to share with you is regarding to the closure of landfills in Malaysia, improper closure of landfills in Malaysia and then how we use our groundwater expertise in order to help them to identify the contamination in this particular site. Okay, in terms of landfill in Malaysia, so for those who – who are not familiar with landfills, so landfill is a place where you dump your solid waste and you cover - you cover it with a – a layer of silts or a layer of clay on top of it. So, in terms of numbers of landfill in Malaysia, we have about 296 landfills altogether and then we have 103 - 131 closed landfills and then we have 165 landfills that are still in operation in Malaysia. And this – this is the source that I got from the National Solid Waste Management Department 2013.

And then, our government has done quite a tremendous job in order to get these landfills closed and then we have spent about 294 million ringgit, which is about ¥9.7 billion in order to get part of these landfills remediated. So, we managed to remediate about 16 landfills in Malaysia properly closed, properly – properly restored and then using for any other purposes in Malaysia, yeah, but the cost is very, very high. It’s about ringgit Malaysia – 294 million ringgit Malaysia. So, this is how the work is shifting from another organization to another organization. So, this is Department of Solid Waste that creates this job and then they give it to Cypark, a big company in Malaysia that deals with contaminate - contaminated land. And the part of the job was given to STREC and then STREC give us some options of it in order to look at the groundwater contamination of the site, okay. So, this is how the money flows from Department of Solid Waste to Cypark to STREC and finally some portion arrives in UKM.

Okay, I would like to share with you one of the improper closure of landfill which is not part of this plan, this is different, okay. So, this site is different. The site is named Taman Beringin landfill which is located on the northern part of Kuala Lumpur. You see this is the city center of Kuala Lumpur and then the landfill is located here. There is a river that flows very close to the site into a big pond here and then it flows directly into the city center of Kuala Lumpur, okay. And then, this is part of the project to see whether is there any contamination of this closed landfill into the river and then the leachate flows into this big pond which is located on the southern part of this landfill. So, this is a closed landfill that was closed in 2005, but the problem with leachate is now resurfaced and then now the leachate is impact or has impacted the river and also the lake which is located on the southern part of this area. Okay, how they close this landfill? This is the before or during the operation of the landfill and then this is after of the – the closing and then they just put a layer of impermeable layer which is a plastic layer and then they put a thick clay on top of it and then put the grass on top of it, you have - they have also this type of gas, but they didn’t do anything at the bottom of the landfill, there is no landfill liner, so we expect more leachate to flow into the river from underneath of this landfill site and then there is no leachate treatment system in this particular area here.

**00:34:59**

Okay, this is the site before restorations and then after restorations. Another photos to show you before restorations and also after restorations. So, this is the problem with the sites. They have a river here and then the river flows straight to Kuala Lumpur area and then there is a big pond, which is called Nanyang Pond and then there – there was a project regarding to this river which is called “River for Life project.” It’s a project to – to – to make sure that there is no – no contamination to the river in Malaysia. So, the project was conducted by Department of Irrigation and Drainage Malaysia and then before – before this, they have done extensive work in order to sample the water and they discovered that one-third is polluted by probably leachate that come out from this area. And they have plan – they make a plan in order to construct impermeable wall between this landfill and also the river and then the depth that they want to build is about 5 meter depth, okay, into the ground and then our task is to identify or to – to – to – to research whether the wall, the 5-meter depth wall is effective or not, all right.

So, they – they are – they are – they are in process of tendering the project to the company to build this 5-meter depth wall, but before they build it, they will like to hear a second opinion from a geologist or from the hydrogeologist about this particular site. So, they try to install impermeable wall which is about 5-meter depth along this river to prevent the underground migration of leachate into the river. So, the main question now is, is it effective to build this wall? Then in order to study the effectiveness of putting this impermeable wall in between the landfill and also the river, our team has come out with the modeling study by using this effective tool, a powerful tool in order to investigate or model the migration of contaminants under the ground by using a software which is called Visual MODFLOW Pro. So, it’s a very technical presentation that I should give you in order to explain about all this model or how to start this model. But I just want to show you some result. So, if we look at the original plan of the – the setting up of this wall according to the – the Department of Irrigations, they want to build a wall here 5-meter depth and then we model this phenomenon by using the Visual MODFLOW and then this is the wall that they want to construct. It is about 5-meter depth. And then this border shows that although they have built a wall which is 5-meter depth, there is still a potential of contaminating that will occur underneath this 5-meter depth of wall, okay. So, we - you can see here the pool [ph], the migration of leachate underneath the wall because this is considered as permeable. This is considered as groundwater. The water will flow through here and then will fall in the river and then the 5-meter depth of wall will not be very effective in order to stop the migration of leachate into the – into the river. And then we tried to recommend a few options. The first one is to build a wall with a depth of 15 meter. So, now the wall – now the wall is construct until it reach the impermeable layer under the – under the – under this river, so the depth is about 15 meter. So, when you build 15-meter depth of wall, then you can see that the leachate of the ground water will shift its movement not into the river, but now into the pond, okay, after 20 years of modeling. Then, we recommended a new design with the L-shape with the length of 365 meter with the depth of 65 meters.

**00:39:59**

After some time, it managed to control the – the movement of the leachate in some time but after 1450 days, you can see the effects which is called the sub-surface dam. So, it is like you dam or you try to stop the movement of leachate under the ground, but with time, it will try to find a way in order to escape this kind of wall and then it will pollute the river and also the lake on the southern part of the - of this area. So, now we recommend another options by putting a wall under the ground and also putting under the pumping well – putting a well that you can extract the water out from the ground, okay. And then we propose this pumping capacity which is about 1000 cubic meter per day in order to extract the water out, but there is still a risk of this groundwater – this contaminated groundwater to enter a big pond which is located in this part of the – the site. And then we modify the options. We say that we can build a wall surrounding this area and then putting a pump in order to extract the contaminated water from the site with a pumping rate of 1000 cubic meter per day and then it is like a funnel and gate. You try to channel the contaminated groundwater to flow into this gap and then you can put several boreholes in order to pump this water out from this – from this – from this system, okay.

And then finally there is a progress about the sites where they try to – to build this kind of design in order to pump all the contaminated water out of site and then they also have a new plan to build a big insulator [ph] on top of this particular site.

So before I finish, I will like to share with you about the phenomenon of abandoned mine sites in Malaysia. Malaysia is blessed with so many minerals like golds, tins, manganese, irons, but we do have a problem with our regulations because we don’t have a very good regulations regarding to mining. And then at the end the - after the mining activities, the operators will leave the area and then this will happen after some times. We got problem with the acid mine drainage because of the interaction of minerals with water and air that produce a very low pH of water in that particular mine. So we have visited several mines in one state of Malaysia which is called Pahang, okay. This is the largest state in Malaysia – in Peninsula of Malaysia and then we try to check the pH of the water in several mines in that particular area. You can see this is a Sungai Lembing with a pH of 3.8 and then this is Bukit Ibam, the pH is about 2.79 and then it’s very interesting because the water is blue in color. It shows that the content of copper in this water is very, very high and then you can see that the – that the color is blue, very nice view of the lake, yeah. And then this is another – another lake but this one is green because of the algae and the pH is about 4.75. Another mine, another pond with a pH of 2.38 in Bukit Botol in Chini. And then, this is also another mines in Padang Piol and also in Kampung Awah quarry, but the pH is very high, 8.05 and 7.85 because the sites was very lucky because there is lot of limestone in that particular sites. So limestone is a rock that contains calcium carbonate that can neutralize the formation of acid in this particular area here. So it gives advantage for the mining activities if you do find the – the lime or limestone in that particular – in your mine. So, it can neutralize neutrally the acidity of the – of the mines.

And then what we – what we – what we are doing with the research in terms of acid mine drainage in Malaysia. Nowadays my students are conducting several experimental work and also environmental monitoring at these particular sites.

**00:45:00**

So we do – we are doing environmental monitoring to check the pH and also the heavy metal contents of the water. We also conducted a test which is called Toxicity Characteristics of Leaching Procedure in order to check the hazardous or leaching capability of the materials that might produce acid mine drainage for that particular site. We also conducted remediation of acid mine drainage using lab scale tank experiments by using different materials such as zeolites, activated carbons, bentonite, and also limestone which is – can be easily collected in several [Unclear] in Malaysia. And then we also do sort of like predictions of acid mine potential. So that means before the mining operator decides to build a mine in that particular area, we can predict the potential of production of acid mine drainage in the future by using acid-base calculating method in order to predict the formation of acid mine drainage in the future there.

So this is some of the photos of the environmental monitoring of the pH and also collecting some samples for heavy metals contaminations. We can see the pH is very, very low. It is about 2.79 in this wonderful lake in Pahang. And also we con – we have also conducted several experimental work in order to study the effectiveness of using several materials to neutralize the acid mine drainage by using bentonites, by using activated carbons, zeolites, and also limestone in the laboratory.

So, I think that’s the final – this is final slide of our presentation today. And then I will like to conclude that Malaysia is now heading towards a better management of its environmental issues especially regarding to contaminated sites in Malaysia. And then currently, we have new guidelines which is called New Contaminated Land Management Guidelines, and then hopefully these guidelines can be turned into legislations, can be turned into law, and any polluted party in Malaysia has to abide or has to follow these guidelines in order to remediate the contaminated sites in the future. And then by developing these new guidelines in Malaysia, the management or properly manage of cont – of the contaminated land has become more effective. And then Malaysia is going towards the effective way of managing our contaminated land in the future.

So, I think that’s about it of my presentation today. Probably you might find it very difficult to understand about these, you know, topics, especially regarding to the geo-environmental topics and then if you have any questions, any comments, so I will like to share with you anything that you think valid for our discussion after my presentation today. So with that, I would like to thank you for your kind attention in this presentations and then it’s my pleasure to be here this afternoon and then to share with you some of the results or some of the research or consultation work that I have been doing in our – in mine - in Malaysia until today. So, with that, thank you so much. *Arigato gozaimasita*.

**END**