Round-table talk

How can we push forward carbon neutrality as our own thing? Suggestions from middle-aged engineers

Panelists

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Moderators

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The target year for the achievement of carbon neutrality is 2050, around 30 years from now. Accordingly, it will be up to the younger generation that will constitute the future leaders of the civil engineering industry to achieve this target. We held a freewheeling discussion with middle-aged engineers who are active in the areas of policy, materials and energy to get their thoughts about the issues that will need to be resolved and prospects for the future.

Moderator First, I'd like to ask each of you to talk about your research and activities in your areas of speciality.

Ogawa I conduct research focusing primarily on applications for fly ash, a byproduct of the coal-fired power generation process, at the Structural Materials and Concrete Structures Lab at Hiroshima University. From the standpoint of carbon neutrality, cement emits large quantities of CO_2 during manufacture, so I'm also studying construction materials that can reduce the amount of cement that is used — for example, substituting fly ash for cement during the concrete manufacturing process, or using blast furnace cement that contains blast furnace slag fine powder, or using geopolymers that do not use cement.

Yoshida I work in the Engineering Affairs Division of the Ministry of Land, Infrastructure, Transport and Tourism — MLIT for short. Among other duties, I'm in charge of liaison for technical development and new technologies. At MLIT, we've established a working group for the creation of a "green society" through the achievement of carbon neutrality by 2050 and dealing with climate change and so on. This working group serves as the secretariat that coordinates with other departments.

Watanabe I work at a renewable energy company that's part of the Tokyo Electric Power Company (TEPCO) Group. I'm in charge of market transactions for the hydraulic, photovoltaic and wind power that is generated, as well as devising strategies for selling to retail energy companies.

Moderator Next, let's talk about the latest topics involving carbon neutrality in each area. First I'd like to hear about national trends from Mr. Yoshida of the Ministry of Land, Infrastructure, Transport and Tourism.

Yoshida I'd like to talk about the studies conducted by MLIT's Green Society Working Group. First let me provide some background on the establishment of the working group. There have been efforts worldwide to achieve a green society, and in October 2020 Japan also declared a goal of achieving carbon neutrality by 2050. In a policy speech at the start of the Diet session, the prime minister touched on the virtuous cycle between the environment and the economy and vowed to make the achievement of a green society a

top priority. The prime minister also discussed current issues and future initiatives, and announced the establishment of a Green Growth Strategy with ambitious targets in each of 14 crucial areas. This is also an area with deep connections to many departments at MLIT, such as those concerned with logistics, the mobility and civil engineering infrastructure industries, the residence and building industry, and the shipbuilding and ship machinery industry. Accordingly, the working group was established in March of this year to accelerate efforts toward the achievement of a green society within the Ministry as well.

Moderator Could you talk a little more about these activities and discussions?

Yoshida In order to establish and implement policies, our aim is to coordinate activities in wide-ranging areas that support the lifestyles and economies of local communities with other ministries as well as with industry and local communities and hold discussions that include feasibility. Up to now, we've had local governments, research institutions and companies tell us about their pioneering efforts relating to carbon neutrality. At present, we're clarifying the issues that need to be resolved to pursue each initiative and the requests from the national government and so on, and discussing what initiatives should be pursued in a unified manner within the ministry.

Six areas involve civil engineering, but it is the construction industry that will take the lead in achieving carbon neutrality and a sustainable society throughout the entire infrastructure life cycle. New technologies developed to this end include in particular "promoting ICT execution in the construction execution fields and promoting widespread use of innovative construction material" and "promoting the use of materials, etc. that help to reduce CO_2 emissions." From this point on, we will pursue projects that will help to achieve these objectives.

Reducing CO_2 emissions using cement byproducts in a "local production for local consumption" manner

Moderator So you're encompassing everything from upstream processes such as planning and materials to downstream processes such as dismantling and disposal. How do things look from the standpoint of materials?

Ogawa From the perspective of my research field, regarding materials for reducing CO_2 emissions, I guess the effective use of byproducts such as fly ash and blast furnace slag fine powder would be applicable. But compared to blast furnace slag fine powder, using fly ash would be more difficult in terms of versatility.

Fly ash has primarily been used for dam concrete and the like in order to reduce the heat of hydration. In recent years, it has attracted attention for its use in rebuilding roads in the aftermath of the Great East Japan Earthquake of 2011, and for increasing the resistance of concrete to salt content penetration. Although there have been many research achievements, both in the distant past and very recently, so far none have led to generalized use.

Fly ash is a byproduct of the coal-fired power generation process, and its properties and quality will differ depending on the type of coal, the time at which it was produced, the cooling process, and the degree of grinding of the powdered coal. In contrast, blast furnace cement is pulverized blast furnace slag, a byproduct of the steel manufacturing process, so its quality is comparatively easy to maintain, making it easy to use. The fact that the fly ash reaction is mild is another reason that its use has not become widespread.

Moderator What sort of proposals are there to promote the generalized use of fly ash?

Ogawa This is not the same as generalized use, but from the perspective of promoting use, there are ongoing efforts to increase the quality of concrete in which fly ash and blast furnace slag fine powder are mixed. One example is irregular roof tiles that use fly ash concrete as an internal curing material in an effort to improve performance. When fly ash is used in concrete as an admixture material, a long wet curing period is required, but it has been

confirmed that the use of coarse aggregate from discarded roof tiles results in improved concrete performance.

The irregular roof tiles are Sekishu-gawara roof tiles from neighboring Shimane Prefecture, and the fly ash is discharged by the Chugoku Electric Power Co., Inc. As CO_2 emissions will be produced if the manufactured products are shipped, in our research we make an effort to always give consideration to resource recycling and local production for local consumption.

Moderator What is the impact from CO_2 emissions in cement manufacture?

Ogawa CO_2 is emitted in the course of manufacturing cement. In addition to the CO_2 originating from the materials, fossil fuels are used in the firing process during production. Japan is becoming able to fire while conserving a considerable amount of energy, but the process accounts for approximately 4% of total greenhouse gas emissions. In the cement materials field, many people are engaged in research into the use of byproducts, the use of low temperatures for firing cement, and finding ways to have the CO_2 emitted during the manufacturing process be absorbed in waste materials.

Prospects for achieving carbon neutrality as seen by middle-aged engineers

Moderator What sort of changes will be needed in specialist fields to achieve carbon neutrality? What are the prospects and the issues to be resolved?

Yoshida This is just my personal view, but I think it will be difficult to achieve carbon neutrality by 2050 unless changes premised on decarbonization are made. The things that are built today, whether residences, bridges, roads or other types of infrastructure, will remain as stock thirty years from now in 2050. For now, we need to build structures that help to reduce CO_2 emissions.

The buildings that have already been constructed will also need to be maintained and upgraded using state-of-the-art technologies. The same will be true of the review of systems when these technologies are applied. For example, I think that if there are methods for quantitatively assessing the reduction impact of materials that help to reduce CO_2 emissions, it will be possible to shift to materials and construction methods that are even more effective in reducing CO_2 emissions.

Ogawa The use of fly ash and blast furnace slag fine powder and the use of geopolymers will be effective for achieving carbon neutrality. But on the other hand, if I'm asked whether we should halt the use of cement entirely, I don't think that's necessarily the case. In the production process for the cement, wastes that have been produced in other industries that cannot be recycled are received and effectively used. Systems for evaluating environmental performance from the standpoint not only of carbon neutrality but from an overall perspective that includes the receipt of wastes and resource recycling will also undoubtedly be needed.

Watanabe With regard to power generation, it will be difficult to gain the understanding of the people in local communities just by asking permission to build renewable energy power generating stations for the purpose of "decarbonization." I think that rather than pushing this on them in a unilateral manner, we will need to propose regional promotion measures while at the same time promoting the impact in terms of creating jobs, and think of power stations together with the people in local communities as symbols of both industry and lifestyle.

In addition, my personal view is that a good way to deepen understanding of hydroelectric power generation is to conduct activities such as the tours that showcase the attractiveness of the regions where hydroelectric power generation equipment is located and the water source regions, which are offered as a benefit to the people who purchase the aforementioned power generated through water power, as well as the "dam cards" issued by MLIT. We should continue this kind of outreach to regional communities as well.

Moderator How about the role of power companies themself? Household consumption of energy through photoelectric power generation and batteries is expected to accelerate in the future.

Watanabe Yes. In the light of that situation, I think power companies will shift from a main focus on selling electricity to one of thinking of how to get customers to use electricity. In the future, they will shift to thinking about how electricity is used in communities such as smart cities.

Yoshida MLIT is also promoting efforts to create "Compact Plus Networks" that link smart cities and compact cities. I think this should be promoted through collaboration on the part of industry, academia and government.

Toward the future of the civil engineering industry

Moderator Guidance for systems design will be needed as well. Finally, what advice would you give about the future of the civil engineering industry?

Yoshida Considering the Japan of 2050, Japan will be compelled to undergo great changes, not only with regard to carbon neutrality but also in terms of infrastructure, due to the declining birthrate and aging society as well as population decline. By 2050, automated driving may be a new technology that is in practical use. If fully automated self-driving vehicles were to become a reality, traffic congestion and accidents would decrease dramatically, and road environments could be expected to have a more prominent aspect as safe public spaces than they do at present. If that happened, we would need to study whether infrastructure should be redefined in terms of the ways in which road spaces should be redeployed, or whether they should be reused as spaces for people. MLIT is also promoting initiatives relating to the digital transformation or DX. From now on, infrastructure maintenance data will be stored in digital form, and this will result in more efficient and optimal inspections and repairs. I think that skillfully increasing the efficiency of tasks that were previously accomplished with manpower will also aid in efforts to achieve carbon neutrality, and the benefits can be returned to society to create the abundant lifestyles that are in keeping with the society of the future.

Ogawa It's also important to pursue research into innovative construction materials in order to achieve carbon neutrality. But I think rather than focusing all of our efforts in one area, we need to have a wide-ranging perspective and a balanced approach that does not discard existing byproducts such as fly ash. Coal-fired power plants are not going to disappear immediately.

It will also be important to get people in the local community to view civil engineering as an attractive industry. Many people still think of civil engineering as something that destroys the environment to build enormous structures. We need to get them to view the industry as one that uses digitalization and advanced technologies to contribute to society and the environment by building things that will last for 100 to 200 years. I think capturing the hearts of parents and small children will lead to an increase in the number of students who want to become civil engineers.

Watanabe At the design and construction stage for civil engineering structures, I think it will also be necessary to consider future uses and maintenance that can accommodate changes in societal circumstances. Nowadays pumped storage hydroelectric power stations are also being used in ways that are in keeping with renewable energy systems.

Civil engineers are involved in project management throughout the entire process of planning, design, ordering, construction and maintenance. For this reason, I think we need to contribute to the establishment of smart cities that take into account the purchasing process for raw materials and the uses of facilities following construction. Accordingly, it will be more important than ever to establish a dialogue with different industries and share ideas.

Moderator This interview provided me with a real understanding of the way in which issues that need to be resolved in order to achieve carbon neutrality are coming to the fore, and the way in which efforts are underway in various fields. I hope the knowledge in various parts of the civil engineering industry can be shared and put to good use in the future.