Sound power generation

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There are a lot of sound power stations all over the world. For example, thermal power stations, nuclear power, hydro power. However, thermal power stations and nuclear power stations influence our environment.

So, we have to make more electricity by renewable energy to improve our environment. Therefore my team focused on renewable energy and we researched sound power generation. There are no sound power stations in the world yet because it is very difficult and is a low efficiency to generate electricity. Our goal is to increase the efficiency of making electricity by sound. From previous research, we knew that we can collect sound more efficiently by using a parabolic reflector. So our hypothesis is if we use parabolic reflector made of harder materials than previous research, we can increase efficiency to generate electricity and we experimented with that. As a result, our hypothesis is correct.

1 Background

Japan, now depends on generation by the drying up energy such as thermal power generation and the nuclear power generation.However,Oil, coal, uranium are used as the drying up energy are limited.Therefore,it is generation by the renewable energy such as solar power generation, wind power generation, are hydro power generation attracts attention.The sound power generation does not attract attention in their generation.Sound has power. For example, sound can break glass and make waves on the water. So, we think, if we can use the power made by sound, we can make electricity from them.

However there are no sound power stations because it's very difficult and has low efficiency to make electricity. So our goal is to increase the efficiency of making electricity by sound. From previous research,we know that we can collect sound more efficiently and increase the amount of voltage. Our experiment focuses on the material of parabola reflector and makes the hypothesis that the harder materials can increase the efficiency of making electricity.

2 Materials and method

We will explain about the devices which are used in the experiment.

・piezoelectric element (fig1L)

It's a generator which can make electricity by changing shape.

・parabola reflector(fig1R)

It's a device which can collect sound and light in one place.

The piezoelectric element is an unfamiliar device, but it is used as a familiar tool in the sound research field. Electric lighter is a good example of using a piezoelectric element. Electronic lighters have a structure as shown in Fig. 2. By pressing a button, a piezoelectric element is deformed to generate electricity, which is then used to ignite gas.

fig.1 piezoelectric element and parabolic reflector.

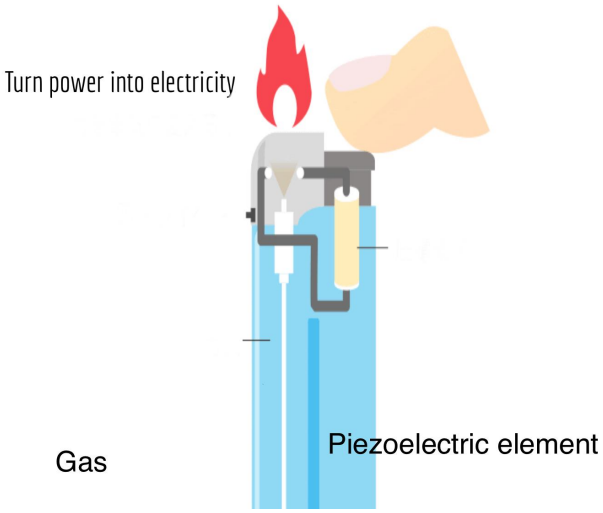


fig.2 for example of using piezoelectric element

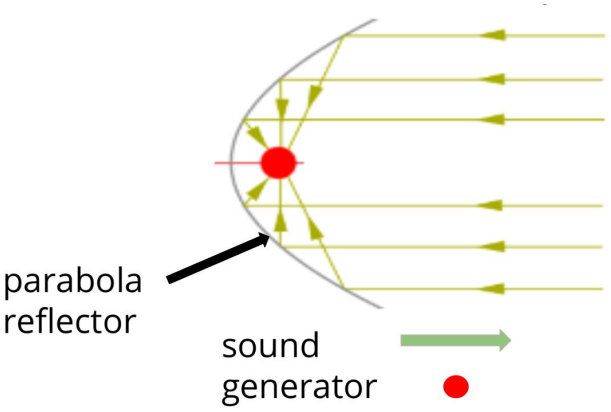


fig.3 experiment

In our experiment we use the piezoelectric element, palabora reflector, speaker, and oscilloscope.We put these items like fig3. theGreen arrow is the sound wave, and the red circle is the piezoelectric element.
We prepared parabola reflectors of different materials and measured the amount of electricity generated.

fig.4 experiment scenery

These are actual photos.(fig4) In these pictures, we put a piezoelectric element outside the parabola reflectors to make it easier to see, but in the experiment we put piezoelectric inside the parabola reflectors.

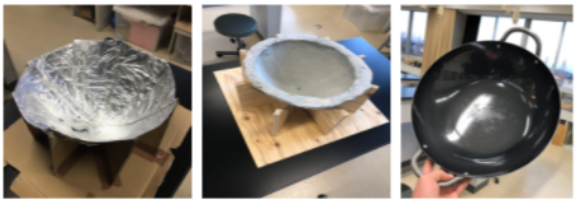


fig.5 actual parabola refrector

Fig5 are actual parabolic reflectors.From left to right,a refractor made of aluminum, made of mortar, and wok. We used the wok because it resembles the shape of the parabola reflector.Here are the functions for each parabola reflector. Also,there are two functions in the wok.

Made of aluminum :y=x^2/16

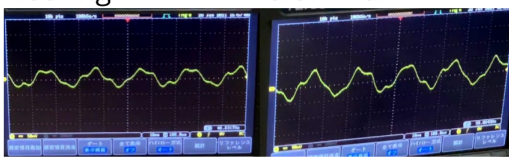
Made of mortar :y=x^2/16

Wok :top y=x^2/20-2.25 bottom y=x^2/90

We tested it using these three kinds of parabola reflectors and checked how a voltage changed when We changed the hardness of the parabola reflector by comparing a voltage.

3 Result

nothing aluminum



mortar wok

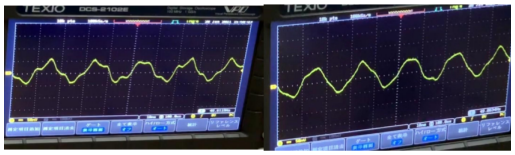


fig.6 actual wave

	Without parabola reflector	Made of alminum	Made of mortar	Wok
First	35mV	53mV	55mV	54mV
Second	45mV	52mV	53mV	60mV
Third	40mV	48mV	50mV	50mV
Fourth	34mV	50mV	63mV	52mV
Fifth	48mV	54mV	54mV	68mV
Average	40.4mV	51.4mV	55.0mV	56.8mV

fig.7 voltage through parabolas

Fig6 is the actual wave.

Fig7 is a table that quantifies fig6.

From left to right:without parabola reflector,aluminum parabola reflector,mortar parabola reflector,and wok.

We did each experiment five times and produced four averages.From left to right:40.4mV,51.4mV,55.0mV,56.8mV.

From this data the voltage increases as the material of the parabola reflector becomes harder.

4 Consideration

Next our discussion.

The first is,once again,that it's better to use a parabola reflector.So it turns out that the previous research was right.

Secondly,the results were not stable and the rate of increase in the amount of voltage was small, so we thought about how we could increase the rate of increase in the amount of voltage.

Thirdly we thought that the opposite sounds were canceling each other out. (fig.8)

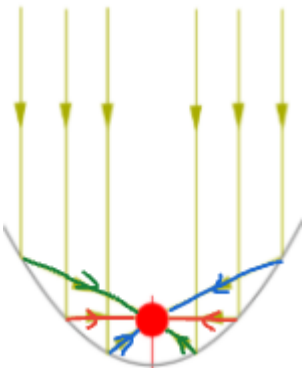


fig.8 sounds were canceling

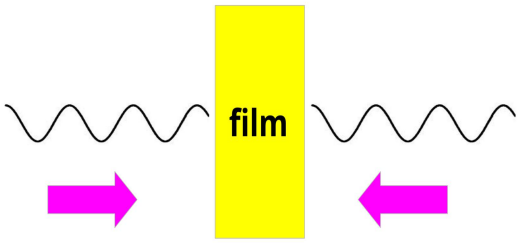


fig.9　sounds cancel each other

Usually,sounds overlap and get stronger at the focus point.However, when film such as a piezoelectric element is sandwiched between them, sounds in the same phase cancel each other out in a dense and dense or sparse and sparse manner.(fig.9)If they are the same power, so they cancel each other out.We believe that the energy of the sound is reduced by the cancellation of the sound, and the piezoelectric element is not deformed much, resulting in a lower voltage.

However, by placing the focus point on the outside of the parabola reflector, only the sound from below can hit the piezoelectric element. That means the voltage level will increase.

5　Future prospect

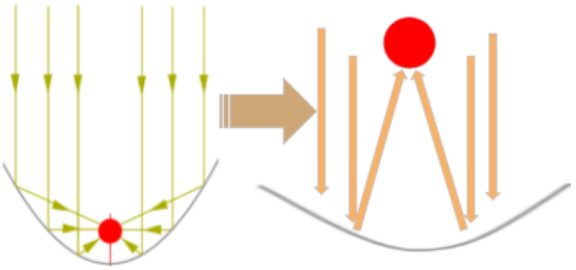


fig.10　raise focal point

The focal point is raised as shown in Figure 10. We thought that we could eliminate the sound in the reverse direction by making all the sound reflected on the parabola reflector hit the piezoelectric element from below. To make the focal point outward, the parabola reflector needs to be flatter.

However, this is only true if the sound is not attenuated or scattered. In reality, flatter is not always better since these things must be taken into account.Our future goal is to conduct research and collect data to find the optimal position of the focal point.

On the other hand, as mentioned above, it was also confirmed once again that the efficiency of sound power generation is significantly lower than that of other renewable energies. This is undoubtedly one of the main reasons why sound power generation has not been put to practical use among other renewable energies. In this study, we have focused on the material of the parabola reflector as the cause of the low efficiency of sound power generation, but this is not the only cause. For example,

piezoelectric elements are used in the power generation floor[5] (a floor that generates power by using the vibrations of people walking) that East Japan Railway is conducting demonstration tests on, and the company is working to improve it every day with the goal of generating a total of 500 kW/s of power per day.In addition, in 2018, Professor Fumio Narita of Tohoku University Graduate School and Tohoku Special Steel Co., Ltd. jointly developed a clad steel sheet that is said to have a vibration power generation function beyond piezoelectric device[6].We are working on applications for existing power sources and energy harvesting. In this research, we used piezoelectric elements, which are lightweight and low cost, because we aimed to put them to practical use in familiar places such as construction sites and along roads. If we want to use sound power generation in these areas, we should modify the materials or devices to improve the efficiency of power generation.In this way,the instruments currently used for sound power generation are being improved day by day and are pushing towards practical applications. If it is more developed, it would help to realize the generation of systems which use renewable energy.

6 References

Power generation using piezoelectric elements

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Electricity, Magnetism and Fine Ceramics - Piezoelectricity

https://www.kyocera.co.jp/fcworld/charact/elect/piezo.html

Pictures of piezoelectric element (fig 1)

https://eleshop.jp/shop/g/gE3S367/

Image of a parabolic reflector (fig1)

https://ja.wikipedia.org/wiki/%E3%83%91%E3%83%A9%E3%83%9C%E3%83%A9%E3%82%A2%E3%83%B3%E3%83%86%E3%83%8A