

# **2003 TAIWAN INTERNATIONAL SCIENCE FAIR**

**CATEGORY : Environmental Science**

**PROJECT TITLE : Why rainbow didn't appear in  
polluted atmosphere?**

**AWARD : First Award, Environmental Science**

**SCHOOL : Buyeo Girl's High School**

**FINALISTS : Ga-ya Noh , Sang-mee Park**

**COUNTRY : South Korea**

## Why rainbow didn't appear in polluted atmosphere?

Ga-ya Noh, Sang-mee Park

### Contents of Abstract: (maximum 500 words) include

#### a. Purpose of the research

These days we hardly see fireflies, the Milky way, and rainbow. What's the reason of that? We think the reason is related to air pollution but the concrete reason is unknown to us. Thus the purpose of this research is to see the relation between air pollution and rainbow with Aerosol. In this research we approached in some ways about why rainbow didn't appear in polluted atmosphere.

#### b. Procedures

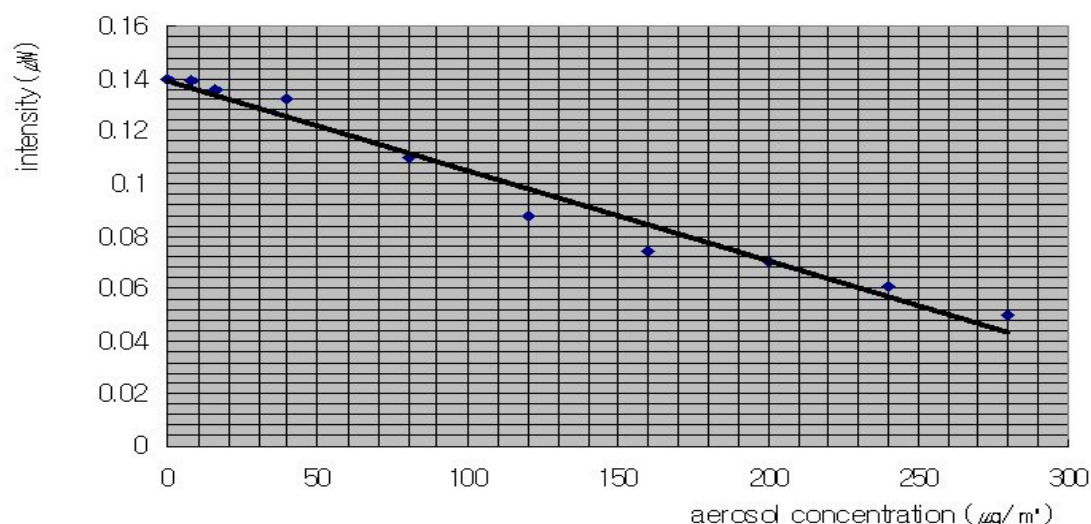
Rubber clay was attached at the tip of wire. Rounded raindrop dropped through grooved rubber clay. By this way we got various size of raindrop. While diluting Aerosol in distilled water, we measured 'Intensity of light' of rainbow in polluted raindrop. Also, we made an experiment in real atmosphere by spraying water through nozzle.

Decrease of 'Intensity of light' was measured like this; A plastic pipe was filled with distilled water. After that we dropped Aerosol thickening solution every five seconds to change Aerosol's concentration.

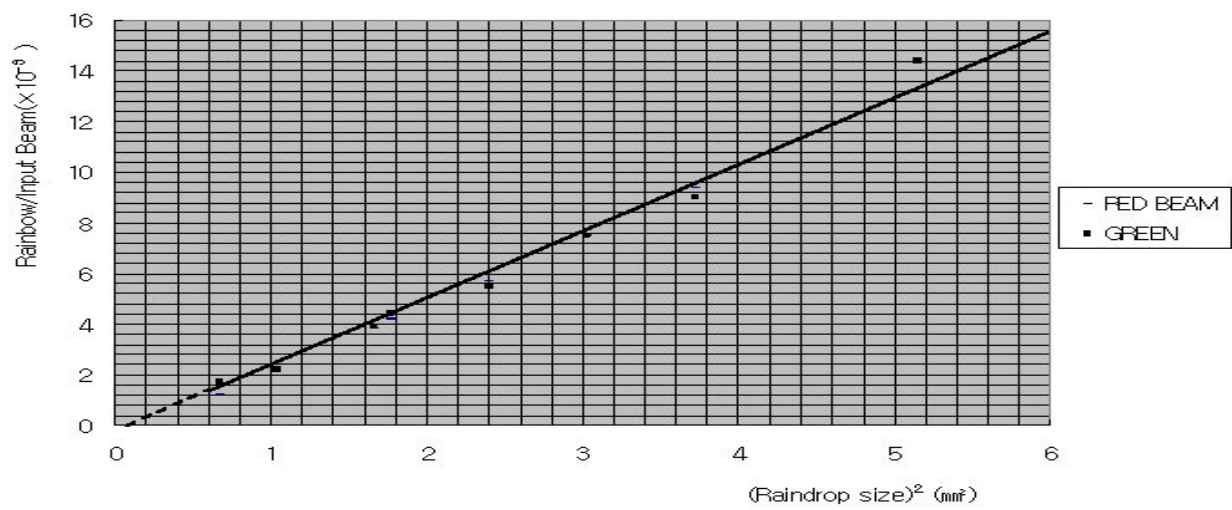
With  $30 \times 30 \times 100$  mm plastic pipe we measured decrease of 'Intensity of light' by haze. Similarly, we sprayed raindrop through humidifier and measured 'Intensity of light' every 5 seconds. We measured rainbow lightness by using color-sheet that is different luminosity. Also, one of the authorities of KMA (Korea Meteorological Administration) confirmed this experiment.

#### c. Data

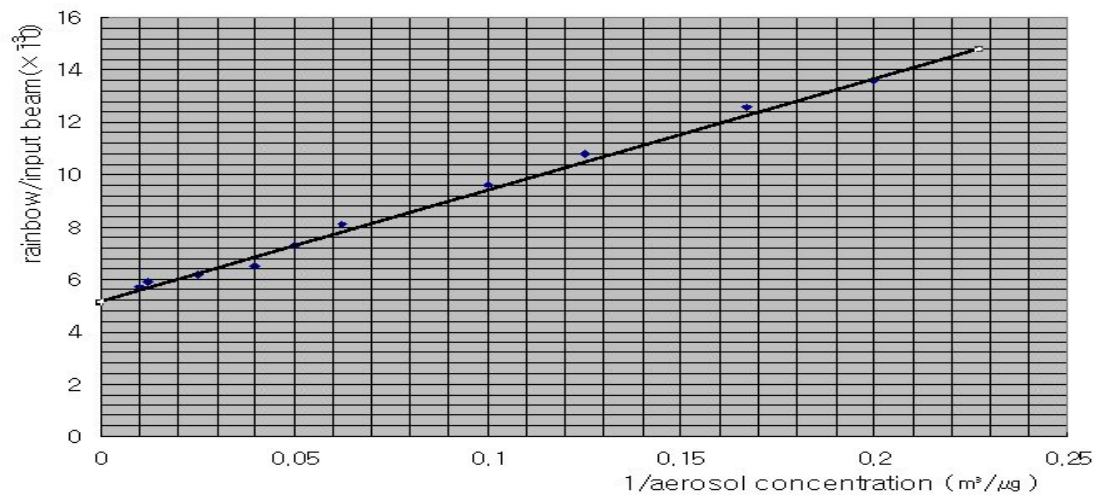
<grape 1> Intensity of light' according to Aerosol concentration in air



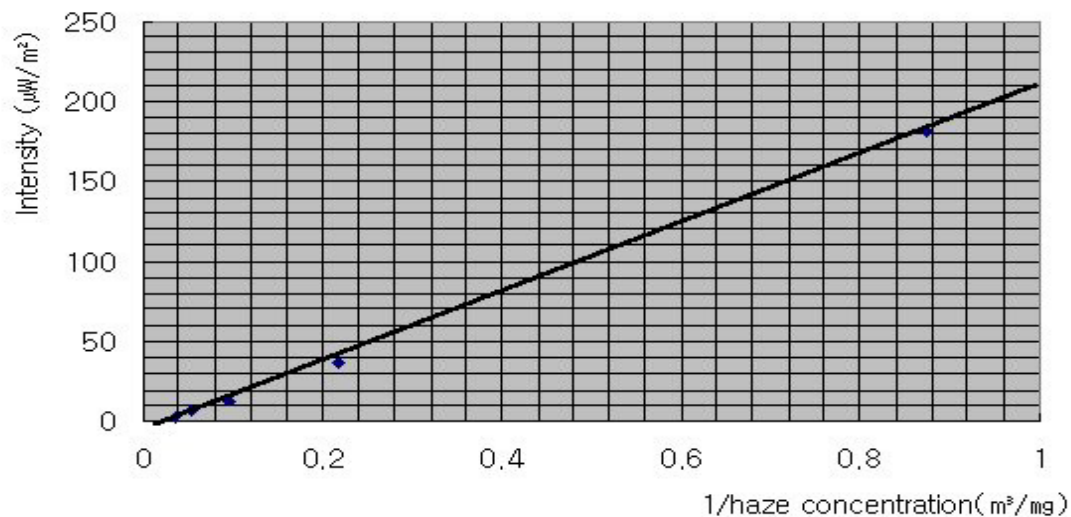
<grape 2> Measurement of 'Intensity of light according to raindrop size



<grape 3> Intensity of light according to Aerosol concentration



<grape 4> Intensity of light according to haze concentration



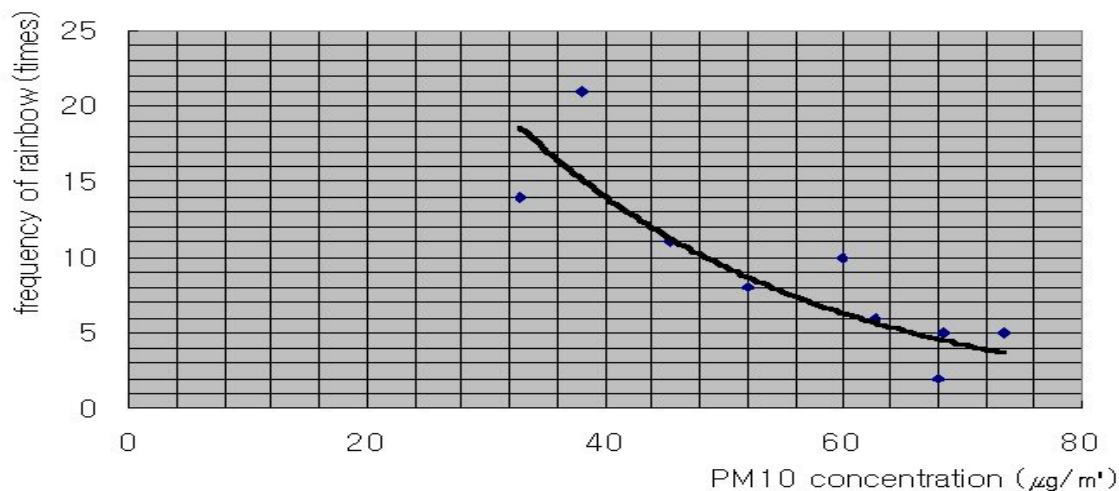
#### d. Conclusions

As the pollution of raindrop increases, brightness of rainbow comes down by scattering and absorption. And spread of that increases.

The formula of 'Intensity of light' is;

$$I = I_0(1 - 2.2 \times 10^{-3} \text{ Aerosol concentration}(\mu\text{g}/\text{m}^3)) \times (\frac{3.4}{\text{Aerosol concentration}(\mu\text{g}/\text{m}^3)} + 0.36) \\ \times [\frac{0.9}{\text{haze concentration}(\text{mg}/\text{m}^3)} - 0.04] \times [0.18 \times (\text{raindrop's size}(\text{mm}))^2 - 0.03]$$

In atmosphere Aerosol has great effect on 'Intensity of light'. Although the result of experiment is like that, 'Intensity of light' is arranged according to brightness of sun and surroundings.



As you can see above the graph, the relation of PM10 concentration and frequency of rainbow-appearance is closely. So when PM10 concentration increases up to  $13 \mu\text{g}/\text{m}^3$ , One of every 5 years rainbow decreases.

Also, if PM10 concentration increases up to  $122 \mu\text{g}/\text{m}^3$ , rainbow disappears completely, we think. This shows that rainbow can be index of PM10 concentration.

Finally, we can measure Aerosol concentration in raindrop by using table of pollution degree in raindrop.

## 評 語

研究構想頗具原創性，其研究方法和儀器之設計也具巧思。