INTRODUCTION

The Chemical Society of Japan has launched “Symposium on Powder Science and Technology” in 1963 with an aim to activate widely covering interdisciplinary fields, and The Society of Powder Technology, Japan, has established in advance by substituting “Chemical” of “Chemical Engineering” by “Powder” in 1956. Since then, industries developed from mass production with scaled up plants to an age of intelligence technology to develop functional material and information technology. The paper provides statistical data with analysis, and interpolate them from a historical view point of science and industries.

ANALYSIS OF SESSION THEMES IN “SYMPOSIUM ON POWDER SCIENCE AND TECHNOLOGY”

“Symposium on Powder Science and Technology” was started from 1963 and those researchers and engineers with a common interest in studying on powder have assembled and earnestly discussed to have accumulated a tremendous achievement.

It accounts 43rd Symposium in 2005. All session themes in the coming symposium are classified and they are allocated as in Fig. 1 [Sewaninkai, Proceedings of Symposium on Powder Science and Technology, (1963–2004)], where numbers are order of the symposium. The most frequent theme is “General” (23), and suggests little dependence on the age. The term is allocated at the top of center and others are blocked into such 4 categories as “Apparatus and Process”(37), “Bulk Particle Behavior & Phenomena”(26), “Build up of Powder and Properties & Characterization” (43) and “Application”(26) as described by vertical lines in Fig. 1. Numbers in parenthesis are taken up times of respective themes.

The category “Apparatus and Process” complies those session themes as “Powder Technology”(6), “Unit Operation”(3), “Process and Unit Operation”(14), “Process”(11) and others(3), and the total is 37. They are corresponded to activity of machinery makers in industries. A term “Unit Operation” was initially used and gradually shifted to “Unit Operation and Process”. In these years when the symposium was started, Departments of Chemical Engineering were successively founded in Japanese universities. “Unit Operation” was a core course in the curriculum, which is evolved to “Process Engineering” in 1970s owing to the development in computer science. The
left hand side in Fig. 1 indicates the tendency. Those session themes are allocated in the right side as “Build up of Powder” (9), “Build up of Powder and the Properties & Characterization” (19), “Measurement and Evaluation of the Properties” (9), “Chemicals” (6) within the block of category “Build up of Powder and Properties & Characterization”. The total is same to the left side being 43. The category is an essential subject in powder science and technology, so that the theme is continually taken up from 1st to 43rd symposium. Subjects on chemistry were initially major, since societies of chemical field took a leadership when the symposium was launched.

Those session themes are allocated from right to left in the lower part as ‘Material Series of Ultra Fine Particles” (4), “Functional Material Series” (10) and...
“Public & Market Series”(11).

Fundamental subjects are allocated from upper right, and industrial subjects are allocated to lower right. Those terms as “functional” and “ultra fine particles” are interested to enhance market value of powder materials and products, and they were seen from the later half of the symposium. This is attributed to the transfer of industries from “mass production and large scale” to “Intelligence Technology”. There is only one session with the term “Nano-technology” which was proposed from United States. It may be attributed that Japanese industries have noticed this subject earlier. The symposium has taken up the subject as “Ultra Fine Particles” several times with interest in various functions to create high market values, and discussed the Intelligence Technology to support industries.

It is a recent tendency that those themes associated with public and market has been notified and discussed as “Environment”, “Energy”, “Bio” and their total times are 9, but it has not been found any theme directly representing “Information Technology”.

Themes associated with subjects on bulk particles blocked as a category “Bulk Particle Behavior & Phenomena(26)” are allocated at the middle part in Fig. 1. They are key subjects on designing apparatus and plants. Themes as “Packing” and “Adhesion and Aggression” were discussed in earlier half of the symposium, and themes were shifted to “Dispersion and Aggression” in later half.

REVIEW OF PAST AND FORECAST OF FUTURE

Session themes “Unit Operation” and “Process” are allocated left side in Fig.1, which are correspond to the field relevant to machinery and plant makers. The Association of Powder Process and Engineering, Japan, surveyed the market of machinery and plant dealing with powder by postulating definition of the territory as a memorial task of The 25th Anniversary of the Foundation in 1996. Followings are the data quoted from the report [AIPPIE, The Association of Powder Process and Engineering, Japan, Homepage (April 2005)].

The market scale of machinery and plant dealing with powder ($\times 10^8$ Yen)

- 1992: 1,788
- 1993: 1,674
- 1994: 1,717

The items (%)

- Bulk handling Apparatus : 16.3
- Granulator : 13.6
- Dust collector : 13.1
- Pulverizer : 10.4
- Dryer : 10.1
- Mixer & Kneader : 10.0
- Classifier : 4.0
- Feeder & Discharger : 3.4
- Instrument : 2.5
- Measuring and controlling device : 0.8
- Others : 15.8

A matrix of technology hybridization indicating degree of repetition was connected with relevance to 15 Technical Groups in The Association of Powder Process and Engineering, Japan, in 1996 as shown in Fig. 2 [AIPPIE, The Association of Powder Process and Engineering, Japan ed., The 25 years History of The Association of Powder Process and Engineering, Japan (1996)]. Based on these data, a vision of 21st century was described for powder technology as shown in Fig. 3 [AIPPIE, The Association of Powder Process and Engineering, Japan, Homepage(April 2005)].
The Association has now organized 19 Technical Groups, such as Bulk Handling, Comminution, Classification and Sieving, Drying, Dust Collection, Mixing and Forming, Measurement and Control, Wet Process, Particle Sintering and Reaction, Particle Modification Technology, Transportation, Clean Technology, Fluidization, Crystallization, Battery Manufacturing Technology, Food Process Technology, and Fine Powder Nano-technology.

These technical groups have respectively indicated their guidelines in such two items as “Recent Subject” and “Near Future Technology” [Sewaninkai, Proceedings of Symposium on Powder Science and Technology, (1963~2004)]. These subjects and technologies are classified here into following 4 items:

A : Process oriented item
i.e., Optimum measurement and control signal, Simulation, Optimization, Automation, Nano process, and so on

B : Unit operation oriented item
i.e., Extension or based on respective conventional technology

C : Market needs oriented item
i.e., Micro structure control, intelligent material, Multi-function complex, Nano-territory, Drug delivery

D : Public and social needs oriented item
i.e., Energy and resource saving, Continue-able Society, Legal control, International standard, Sanitary and safety administration

![Fig. 2 A Matrix for Technology Hybridization Indicating Degree of Repetition.](image-url)
Those classified subjects are summarized as follows.

**Recent Subject**  “Near Future Technology”

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<tbody>
<tr>
<td>A</td>
<td>6.4%</td>
<td>7.0%</td>
</tr>
<tr>
<td>B</td>
<td>42.9</td>
<td>44.2</td>
</tr>
<tr>
<td>C</td>
<td>18.2</td>
<td>27.9</td>
</tr>
<tr>
<td>D</td>
<td>32.5</td>
<td>20.1</td>
</tr>
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These numbers indicate a tendency that the item D oriented to public and social needs is decreased in “Near Future Technology” from “Recent Subject”. This may be attributed to a state of severe competition in industries.

Technology forecast on 21st century surveyed in 1996 has now turned out correctly. Subjects in near future are almost within the prediction. The market scale of particle apparatus and plants would almost be unchanged in coming ten years.

Followings are predicted as themes in 21st century, namely, “Lifestyle and senior people”, “Wave of information innovation”, “Global environment, Release of legal control” and “Quality of public investment”.

**POSTSCRIPT**

A many good studies were reported in 20th Century for predicting technology and society in 21st Century, but little report take account any proper prediction for changes in the triangle of Asia and middle east territory, and also in Africa. Waves of globalization covering tremendous culture and lifestyle would be much larger than that of technology innovation. It becomes important to sincerely discuss the role of science and technology in connection with these themes [Toyama, S., “Nuclear Fission: A Picture Scroll - Berlin-Hiroshima - 21st Century” Nagoya University Museum(2005)]. Now, it becomes obvious the collaborative symposium Busan is greatly worthy as an event in the year of friendship promotion between Korea and Japan.

Fig. 3 Basic Technologies to Open 21st Century - from Macro to Micro.