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# SCIENCE BULLETIN

*National Science Council**2 Canton Street**Taipei, Taiwan, Republic of China*

## Hsinchu Science Park on the Go

The Hsinchu Science-based Industrial Park inaugurated 11 months ago is making satisfactory progress. It promises to be the Taiwan version of the Stanford Industrial Park in the United States.

So far the Park Administration has approved 21 investment projects with six other investment applications under screening. By the end of this year the target of 30 investment projects approved is expected to be reached.

These figures seem modest. But they are impressive when compared with the growth figures of the highly successful Stanford Industrial Park and the North Carolina Research Triangle, where the rate of increase amounts to only two or three new plants a year.

In addition to the 21 investment projects approved for the Hsinchu Science-based Industrial Park, the Park Administration is maintaining constant contact with over 100 foreign firms and has sent inquiries to about 3,000 others. Considering the attractive terms offered and the excellent services available in the park area, many of these firms are expected to apply for investment there. When the park's 10-year development plan is completed, it is certain to achieve its goal of acting as a catalyst in the Republic of China's efforts to upgrade its industrial technology and transform its industrial structure.

The Park Administration has completed construction of public facilities for an area of 100 hectares. Buildings completed include four standard factory buildings of eight units each, housing for executives of 17 park enterprises, bonded warehouse and quarters for police guards. Two more standard factory buildings and 24 housing units for executives will be added in the current fiscal year.

Other construction projects some of which are under way include the

Park Administration Building, dormitories for workers, school for dependents, medical facilities, recreation center and shopping center.

In order to better serve the park enterprises, the Park Administration has sought to establish communication with them by inviting them to take part in joint discussions. This way the Park Administration and the park enterprises can work together to dig up problems and find solutions. It also enables the park enterprises to recommend directly to the Park Administration measures for improvement of services.

The first such discussion session took place last March during which some park enterprises requested for more tax incentives and further simplification of procedures. Acting promptly on these requests, the Park Administration secured the coopera-

tion from other government agencies concerned in effecting the following:

A. Article 17 of the Statute for the Investment and Administration of a Science-based Industrial Park was revised in May to specify that import duties and dues and commodity tax are to be collected on raw materials and components if the goods are not manufactured outside the bonded area.

B. The procedure for shipment of goods into and out of the bonded area has been further simplified.

C. The whole park area has been made a bonded area instead of regarding each park enterprise as an independent bonded area.

Meanwhile, Sino-American Silicon Products Inc. has begun production of silicon wafers in the park for domestic consumption and export. The company also produces silicon bars and other related items.

## NSC Symposium Series No. 3 Off the Press

National Science Council Symposium Series No. 3 - *Proceedings of Republic of China-United States Cooperative Science Seminar on Fish Diseases* has been published. Over the years NSC has sponsored many symposia and has provided financial support to other institutes for the same purpose.

Because the symposia are of great value to academic interaction and technical research in this country. The Council decided to publish the NSC Symposium Series. It's hoped that the publication of the series will contribute to academic exchange and international cooperation in scientific research. The Series No. 1 - *Proceedings of R.O.C.-U.S. Cooperative Science Seminar on Mycoplasma Disease of Plants* - was published in July 1979, the Series No.

2 - *The Causes of Low Yield of the Second Crop Rice in Taiwan and the Measures for Improvement* - was published in November the same year. This volume contains 16 papers presented during a 3-day workshop held in Seattle, Washington on July 21-25, 1979, attended by scientists from R.O.C. and the United States. The Symposium was funded by NSC and the NSF of the United States.

The main purpose was to increase an exchange of scientific information and to have an understanding of the problem relating to fish health. The book has 128 pages. It includes 7 parts - Part 1, Aquaculture; Part 2, Bacterial Diseases; Part 3, Parasitic Diseases; Part 4, Fungal Diseases; Part 5, Viral Diseases; Part 6, Miscellaneous Complaints; and Part 7, Disease Control.



# Catalytic Cracking of Rice Husk for Olefins Or for Hydrogen-Rich Synthesis Gas

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Recent surge of interest in the gasification of biomass prompts us to publish our works in the gasification of rice husk. There has been numerous reports of the thermal cracking of biomass to produce synthesis gas and hydrocarbons via Fischer-Tropsch reaction. This approach provides a new facet to produce useful raw materials from the vastly wasted renewable biomass resources.

We report herein the preliminary study of catalytic cracking of rice husk and bagass pith to produce hydrocarbons whose major components are ethylene and propylene or to produce hydrogen-rich synthesis gas by the proper choice of catalysts.

In a micro fluidized bed reactor containing 100 to 200 gm of solid particles, rice husk, 20 gm, was fed batchwise and fluidized with steam at a reaction temperature of 450° to 550°C. Effects of temperature, residence time, weight ratio of the solid particle over rice husk and that of different catalysts were studied.

In the thermal cracking, almost identical results were obtained whether heating medium of corundum was used or not. Under the comparable conditions, catalysts heating medium and cracking agent provided larger volume of gaseous products (150 cc/gm of rice husk catalytically vs. 100 cc/gm thermally at 450°C.) and higher percentage of ethylene and propylene (5.1% catalytically vs. 1.7% thermally) than did corundum as heating medium in the thermal reaction.

With a commercial silica alumina cracking catalyst, gas volume, 100 to 170 cc/gm, as well as the percentage of hydrogen (1%), carbon monoxide (46%) and methane (8%) increased with the temperature while that of carbon dioxide (29%) decreased with the rise of reaction temperature as expected from the thermodynamic stability.

With this cracking catalyst, a residence time of 2.2 sec. gave rise to a maximum yield of ethylene and propylene (4%) at 500°C. Higher weight ratio of catalyst to rice husk (5 to 10) increased the share of ethylene and propylene in the total gas mixture whose volume also increased.

Of the twelve commercial catalysts

being studied, fluidized cracking catalysts (zeolite type) provided the highest selectivity of ethylene and propylene (5.8% at 500°C). Higher selectivity is expected when reaction temperature and the weight ratio of catalyst to rice husk can be increased; work in this direction is in progress. In another run using an ammonia synthesis catalyst, we obtained a synthesis gas (360 cc/gm) containing 65% of H<sub>2</sub>, 11% of CO, 19% of CO<sub>2</sub>, 3.3% of CH<sub>4</sub> and 1.6% of hydro-

carbons.

In summary, we concluded that compared with thermal cracking, the catalytic cracking of rice husk or bagass pith brings about more gaseous products, better control of product selectivity, and furthermore, the cracking properties of these catalysts resemble to those in the cracking reactions of petroleum fractions. Thus enormous experience of the petrochemical industry can be used as guideline to develop this new industry.

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## Gasification of Biomass

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The rice husk could become an attractive alternate energy source in the area with large production of rice when the industrial gasification process is successfully developed.

To obtain the basic data for preparing the material and energy balances of rice husk gasification process, pyrolytic gasification experiments were carried out in a bench scale experimental system.

400°C superheated steam was sent to the 50 mm dia. reactor at a rate of about 12 g/min to fluidize fused alumina sand in the bed (average size and true density of sand are 250  $\mu$ m and 3.96 g/cm<sup>3</sup>, respectively) and the pyrolysis reaction was performed at 600 - 700°C by supplying reaction heat with an electrical heater. Rice husk powder (average particle dia. 250  $\mu$ m) was fed into the fluidized bed through a screw feeder at the rate of about 700 g/hr. The gaseous products were analyzed by gas chromatograph and the rate of it was calculated from the volume change of gas holder.

From the experiments, the approximate yields of pyrolytic gasification product are: 50 wt % of gas, 30 wt % of char, 2 wt % of tar and 18 wt % of water soluble material dissolved in the condensate of fluidizing steam.

Calorific value of gas product is evaluated as 4,312 kcal/m<sup>3</sup>. Approximate value of the endothermic heat of reaction per kg. of dry rice husk feed in the pyrolytic gasification was estimated as about 200 kcal/kg from the heat balance around pyrolyser.

In an integral gasification process for industrial application, major portion of the char residue is to be burned in a separate fluidized bed reactor to supply the heat needed in pyrolysis reactor. Both pyrolyzer and combustion reactor are connected to form a twin fluidized bed reactor system. The ash obtained in the combustion of char (which is about 15 percent of the feed) could become a valuable product after grinding. 5 T/hr integrated gasification system, which is composed of twin fluidized bed reactor i.e. a pyrolyser and a fluidized bed char combustor, was designed by a simple scale up of bench scale experiments and by using the data of the material and energy balance which was prepared for 5 T/hr integrated process.

Finally, short economical estimation for 500 T/day industrial plant was performed by showing its economical balance. The results of this estimation demonstrate the feasibility of developing rice husk gasification industry.

# Alternative Energy Will Be Minimal Here in Next 20 Years

Taiwan will still be relying on nuclear energy, coal, petroleum, liquefied gas and hydro-power as major energy sources 20 years from now.

Thus concluded a recent conference on energy policy and conservation, sponsored by the Energy Committee of the Ministry of Economic Affairs.

Factors inhibiting the introduction of alternative energy sources to a significant extent before the year 2000 include concerns of production scale, technological feasibility, economics, safety and environmental hazards.

Because world supplies of petroleum will begin to decline reportedly by 1985, the conference said the nation

will be shifting its energy emphasis from oil to coal and nuclear, and will begin importing natural gas.

Though imports of coal are expected to rise to supplement the country's limited supply, that increase will not be particularly rapid, owing to the concern over the impact the burning of coal will have on the environment.

Uranium prices are expected to be somewhat lower this decade than last and the country is making serious efforts to diversify its supply sources from the United States and South Africa to Australia and Canada.

Although the conference noted that the nation has little control over the

sources of energy supplies, it does have room to maneuver in so far as to how the imported fuel is utilized.

To facilitate more prudent energy use, the conference recommended that the government adopt tax incentives for industrialists who take the initiative in conservation efforts, including making equipment retrofits or installing more efficient machinery.

The conference also said the change of the nation's industrial infrastructure from one of energy intensity to one of much greater energy efficiency will also help. The development of a rapid transit system, the conference said, is yet another way to lighten the nation's energy burden.

## Gov't Moves to Boost R & D Spending by Local Firms

The government has decided to formulate measures to boost research and development expenditures of profit-seeking enterprises to 2 percent of annual sales within 10 years.

According to the Science and Technology Advisory Group of the Executive Yuan, only one state-run firm—Taiwan Sugar Corp.—and one government agency—the Directorate General of Telecommunications—spent 2 percent of their revenues for R&D last year. All other profit-making enterprises last year expended less than 1 percent of their sales for R&D.

R&D spending of all profit-seeking enterprises in 1980 only accounted for 0.63 percent of the nation's GNP,

compared with a 2.15 percent figure for Japan.

Consequently, the government has decided to request that profit-seeking enterprises increase their R&D spending progressively over the next ten years.

It is expected that the government will set minimum R&D spending levels for profit-seeking industries and request that those enterprises make R&D investments accordingly. If enterprises should fail to make the proper level of investment, the government could require them to contribute a sum of money equivalent to the minimum R&D requirement to a public R&D fund.

## ROC Succeeds in Developing Nuclear Isotope Device

The National Tsing Hua University and the Nuclear Energy Research Institute have succeeded in developing a 99M Tc Pertechnetate radio isotope device to produce cobalt-60 for application in nuclear medicine, according to the Atomic Energy Council of the Executive Yuan.

The Council says that Tsing Hua and the Nuclear Energy Research Institute have been engaged in radioactive isotope research. The reactor in Tsing Hua can produce 29 varieties of isotopes with an annual production exceeding 12,000 millicuries. The research institute is mainly engaged in

cobalt-60 production.

So far, the Institute has produced over 100,000 millicuries cobalt-60. Free China used to import cobalt-60.

The Atomic Energy Council says that in recent years domestic research institutes have used gamma rays of high energy to radiate on 700 million chrysalises of fruit flies to cause infertility in order to exterminate the insect. In doing so, the government saved NT\$170 million in pesticide expenses, and farmers' income from the planting of fruit increased by NT\$1 billion.

## NSC-Supported Research Projects

Engineering and Applied Sciences

Chen-fa Hsu

NSC70-0201-E002-15

The microprocessor based FFT spectrum analyzers

Ching-lien Huang

NSC70-0201-E006-17

The Study of treeing phenomena in cross-linked polyethylene insulation power cables

Toyotaro Shiramatsu

NSC70-0201-E006-18

Application of new firing process to thick film microcircuit

Chung-chuang Wei

NSC70-0201-E006-19

Preparation and characteristics of new piezoelectric ceramics

Chung-chung Wei

NSC70-0201-E006-20

The study of ZnO nonlinear material

York-yih Sun

NSC70-0201-E006-21

Adaptive combustion control of spark ignition engine

Jih-shaw Tzeng

NSC70-0201-E006-22

Fabrication of  $Ag_6I_4WO_4$  solid-state battery

Shen-li Fu  
NSC70-0201-E006-23  
Preparations of screen printable  
cermet-type thick film thermistor

Chi-fu Den  
NSC70-0201-E009-15  
Design and fabrication of two general  
purpose components

J. Y. Lee  
NSC70-0201-E009-30  
Computer aided topological design and  
correction of integrated circuits

Huan-hsiung Meng  
NSC70-0401-E008-02  
The preliminary test to the practicality  
of the research for a wonderful energy  
source generated by the "Process for  
Actuating a Hydraulic Prime Mover  
through Conversion of Energy in Water  
Current"

Kuo-ming Wang  
NSC70-0401-E007-01  
The study of the reliability and pre-  
ventive maintenance system of electric  
vehicles (II)

Chun-kuan Shih  
NSC70-0413-E007-02  
An assessment study on the sponta-  
neous nucleation model in large scale  
steam explosions

S. F. Ling  
NSC70-0401-E006-03  
On a machine structure design pro-  
gram and its application to the vibra-  
tion reduction of motorcycle structure

Y. R. Hwang  
NSC70-0401-E005-01  
Development of uneven hillside tractor  
(III)

B. T. Yang  
NSC70-0401-E007-02  
Turbulent flow measurement of an  
annual combustion chamber using  
Laser Doppler Anemometer

Wen-chang Chiang  
NSC70-0402-E002-04  
The investigation of the optimum con-  
dition for the bubble separation of  
cellulase and lipase

Jer-ru Maa  
NSC70-0402-E006-03  
The studies of vapor-liquid two-phase  
flow and boiling heat transfer  
mechanism

Yung-yun Wang  
NSC70-0402-E007-04  
Development of a high energy density  
nickel-iron battery

Ru-yih Sun  
NSC70-0401-E007-03  
Some improvement studies on the  
manufacture prototype of the electric  
van and the development of the  
electric bus

Shyang-ling Sang  
NSC70-0402-E058a-01  
Studies on ethanol production from  
bagasse or bagassepith

#### Natural Sciences and Mathematics

G. Tai-jen Chen and  
Koung-ying Liu  
NSC70-0202-M002-03  
A study of abnormal rainfall over  
northern Taiwan under the northeast  
monsoon influence in winter season

Shyue-yih Liao  
NSC70-0202-M008-05  
Experiment of numerical weather pre-  
diction with a simple diabatic heating  
model

Tsu-wei Nee  
NSC70-0204-M008-08  
Optical properties of semiconductor-  
modulation spectroscopy

Fu-shong Kuo  
NSC70-0204-M008-09  
Study of nuclear cosmic rays and their  
isotopes of solar flares

Jiang-tsu Yu  
NSC70-0204-M003-03  
Paramagnetic resonance of  $Fe^{3+}$  in  
soda alum

Lu-san Chen  
NSC70-0204-M008-10  
Oscillations of n-th order functional  
differential equations with perturbations

Y. Wang  
NSC70-0202-M002-04  
Basement geology of Taiwan and some  
tectonic implication

Shin-fu Tsan  
NSC70-0202-M002-05  
Petrology of the Tananao Schist in the  
tunnels of the North-bound Railroad

C. M. Wang Lee  
NSC70-0202-M002-06  
Composition of biotites and the co-  
existing biotite-hornblende pairs in the  
metamorphic rocks of the Eastern  
Taiwan

Ching-ying Lan  
NSC70-0202-M002-07  
Distribution, petrology and  
metamorphism of Yuantooshan gneiss  
and related ultrabasic rocks in the  
central range Taiwan

Biological, Agricultural, and  
Medical Sciences  
Shou-kung Sun  
NSC70-0409-B005-15  
Studies of solarization for controlling  
soilborne fungal diseases

Gwo-fang Yuan  
NSC70-0409-B080-01  
Investigation and improvement on the  
sanitary condition of chicken eggs  
during their production and marketing

Chen-kung Chou  
NSC70-0412-B001-02  
Properties of radio labeled presynaptic  
neurotoxins of snake venom

Juei-low Sung  
NSC70-0412-B002-26  
Hepatitis B antigen and antibody in  
liver disease

T. C. Lynn  
NSC70-0412-B002-27  
Long term followup of IgA anti-EB  
antibodies in nasopharyngeal carcinoma

Dorothy W. King  
NSC70-0409-B002-18  
The effect of vitamin C, zinc and iron  
on the cadmium toxicity in the mouse

Kai-mo Chen  
NSC70-0412-B002-26  
A biochemical and morphological  
study on massive resection of the  
intestine

Paulus S. Wang  
NSC70-0412-B010-12  
Effects of thyroidectomy on the *in  
vitro* release of GnRH and responsive-  
ness of rat pituitaries to GnRH

M. T. Lin & J. J. Wu  
NSC70-0412-B016-16  
A study on some physiological  
functions of Raphe nuclei

Fu-sheng Thseng  
NSC70-0409-B005-18  
Breeding studies of the node number  
and length on main stem in soybean  
plants

Shoei-yn Shiau  
NSC70-0412-B002-30  
Effects of nitroso derivatives of anti-  
histamine or development of chick  
embryos

T. C. Tseng  
NSC70-0409-B001-05  
Study on *Fusarium* spp. of Taiwan and  
their mycotoxins and natural products

Ching-yih Chen  
NSC70-0409-B005-16  
Studies on photosynthesis capacity  
and photo-respiration of crops