



**TOGETHER**  
*for a sustainable future*

## OCCASION

This publication has been made available to the public on the occasion of the 50<sup>th</sup> anniversary of the United Nations Industrial Development Organisation.



**TOGETHER**  
*for a sustainable future*

## DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

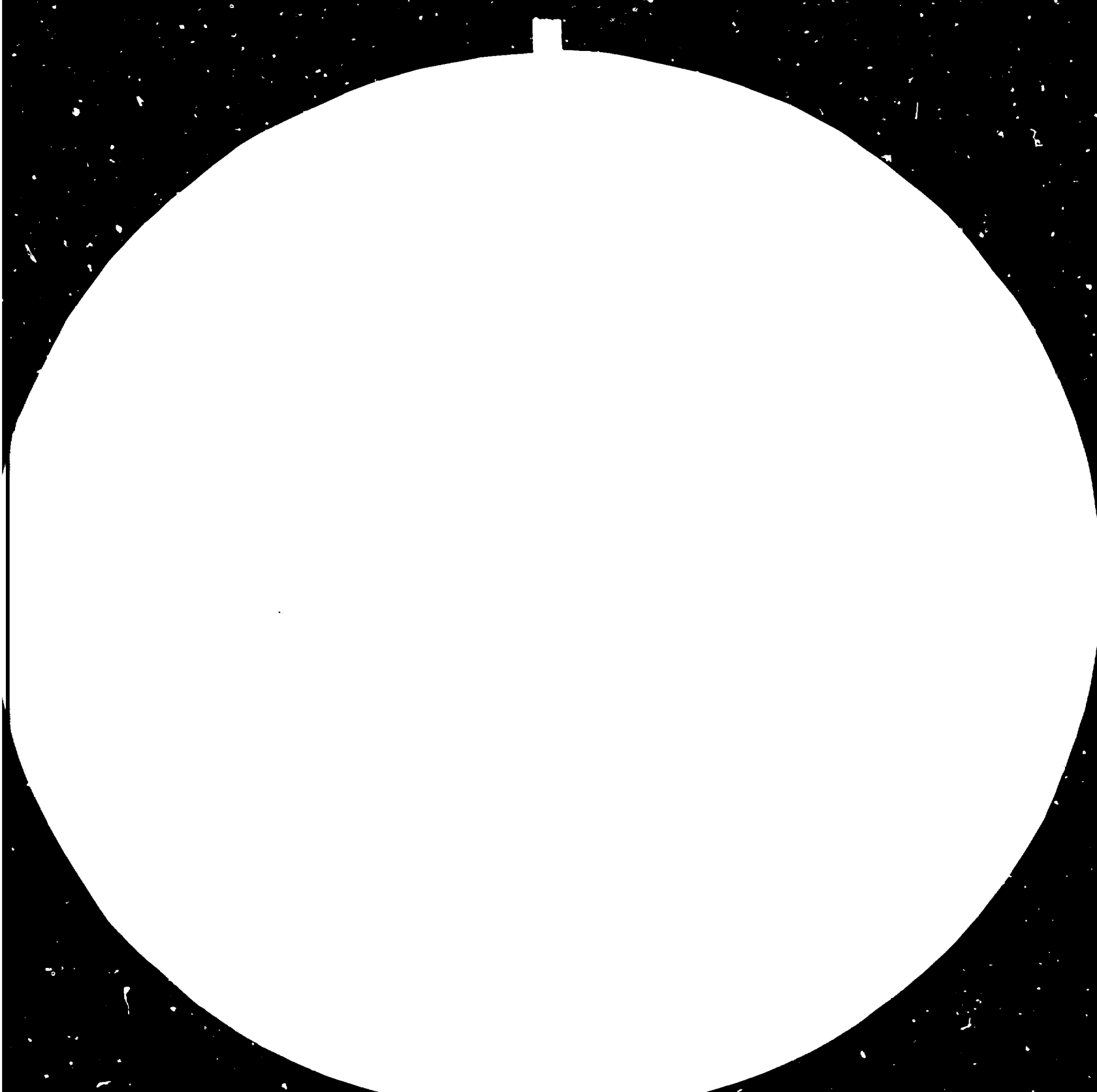
## FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

## CONTACT

Please contact [publications@unido.org](mailto:publications@unido.org) for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at [www.unido.org](http://www.unido.org)





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS  
STANDARD REFERENCE MATERIAL 1010a  
(ANSI and ISO TEST CHART No. 2)



13140 - E



Distr.  
LIMITED

ID/WG.406/8  
6 December 1983

United Nations Industrial Development Organization

---

ENGLISH

Fourth Consultation  
on the Fertilizer Industry  
New Delhi, India, 23 - 27 January 1984

ISSUE NO. 4: MINI FERTILIZER PLANTS

Issue paper \*

prepared by  
the UNIDO Secretariat

1368

---

\* This document has been reproduced without formal editing.  
V.83-64917

i. BACKGROUND

The Third Consultation on the Fertilizer Industry recognised that in many developing countries, in particular the least developed, land-locked and other small developing countries, the demand for fertilizers was not sufficient to warrant large fertilizer plants. It recommended that UNIDO examines mini fertilizer plants based on plants of up to 150 tons per day of ammonia and/or up to 50 tons per day of phosphoric acid (100% P<sub>2</sub>O<sub>5</sub>), which might prove more suitable.

For that issue, several topics should be examined, namely markets for mini fertilizer plants in developing countries, available technologies for those plants, new energy-efficient technologies and engineering designs for model mini fertilizer plants, and recommendations for co-operation between developed and developing countries as well as among developing countries in promoting mini fertilizer plants.

A Technical Conference on Ammonia Fertilizer Technology for Promotion of Economic Co-operation among Developing Countries was convened at Beijing, People's Republic of China, 13-28 March 1982 (report ID/WG.364/38). A review was made of advances in ammonia technology, in particular Chinese technologies for small- and medium-sized ammonia-based fertilizer plants.

A Seminar on Mini Fertilizer Plants was convened at Lahore, Pakistan, from 15 to 20 November 1982 to review the current situation of mini fertilizer plants and its technologies (report UNIDO/PC.61). The Seminar recommended that UNIDO (i) appraises the techno-economic viability of mini fertilizer plants in comparison with large fertilizer plants, for a number of products and capacity ranges, (ii) examines available technologies for ammonia production in plants up to 250 tons per day, (iii) prepares a guide to mini fertilizer plants and (iv) studies the storage and utilization of ammonium bicarbonate in soils outside China, as the product was a low cost fertilizer which had only been tried in that country.

The Seminar considered that no new fertilizer processes were needed except for ammonia, which technology for smaller plants may need further development. In this context, UNIDO commissioned FEDO (India) to prepare the

basic engineering design of a modern 100 metric tons per day ammonia plant, according to the requirements and level of skills of those developing countries most in need of mini fertilizer plants. In accordance with the recommendations of the Third Consultation and the Seminar on Mini Fertilizer Plants, UNIDO is presenting to the Fourth Consultation a study on "mini fertilizer plant projects".

In addition, a "draft guide to mini fertilizer plants" covering the examination of mini ammonia plant technologies, has been prepared as reference.

## 2. THE DOCUMENTS

### A. Mini Fertilizer Plant Projects (UNIDO/IS. 416)

The study aims at appraising the technicals and economic viability of smaller fertilizer plants as an alternative to, or complementarity with, large fertilizer plants up to the year 2000. It follows, in the main, the recommendations of the Seminar on Mini Fertilizer Plants concerning the selected fertilizer products and capacity ranges. The study and its annexures provide the major techno-economic factors of mini plants as a guide for planners and decision-makers of developing countries, to consider mini fertilizer plants as a possible alternative for the development or expansion of their fertilizer industry. The economies of the above plants were evaluated under three locations, one in a developed country and the other two in developing countries, one of the latter being in a remote location the other in a sea-side location.

On mini ammonia plants, the trend towards energy saving solutions by simpler and less sophisticated technology and equipment, the economic re-evaluation of alternative feedstocks to natural gas, and the current economic and financial problems of most developing countries, have enabled the preparation of several new process flowsheets well adapted to mini ammonia plants. These flowsheets have specific parameters competitive with those of large ammonia plants.

Two of these flowsheets are being presented, one for a 150 mtpd ammonia plant, the other for a 250 mtpd ammonia plant. These processes promise better performance than the majority of 1,000 mtpd ammonia plants currently in

operation, with total energy requirements of about 8.3 Gcal/ton of ammonia, in spite of simplified design. These flowsheets could be proven commercially only if interested contractors become persuaded that there is a market which justifies the expenses involved. Smaller plant sizes of around 50 mtpd ammonia, could have similar characteristics to the 150 mtpd ammonia plant presented in the study, but its conversion into nitrogenous fertilizers would be too expensive.

For nitrogenous fertilizers, the study establishes that the farm gate prices of products converted from natural gas-based mini ammonia plants, are competitive with imported nitrogenous fertilizers. However, mini ammonia plants based on other feedstocks convert fertilizers whose farm gate prices are higher than imported fertilizers but lower than prices of fertilizers from large plants located near its feedstocks.

For phosphate fertilizers, the farm gate prices of products converted from mini phosphoric acid plants are very competitive with both imported fertilizers and domestically produced fertilizers in large plants located about its raw materials. Mini NPK plants can provide a viable economic alternative only when ammonia, nitric acid and phosphate processing facilities are located about the same site.

To assess the potential markets for mini fertilizer plants in developing countries, the current and future fertilizer consumption and the availability of raw materials were examined in 91 countries. It was found that in 1981/82, for the consumption range applicable to mini fertilizer plants which is between 10,000 and 70,000 mtpa of nutrient (N or P<sub>2</sub>O<sub>5</sub>), there were 48 developing countries in N and P<sub>2</sub>O<sub>5</sub> mini fertilizer plant range. Of these, there were 22 countries in N and 17 countries in P<sub>2</sub>O<sub>5</sub> in the range between 40,000 to 70,000 mtpa nutrient consumption.

In regard to future fertilizer consumption of developing countries in the range from 40,000 to 70,000 mtpa nutrient, there is the potential to set up 85 mini ammonia plants and 42 mini phosphate plants to 1990, and 130 mini ammonia and 68 mini phosphate plants to 2000. The total investment on the above plants up to 2000 is estimated at US\$ 25,000 million at 1983 prices.

B. Draft Guide to Mini Fertilizer Plants

A guide to mini fertilizer plants comprising two main parts is under preparation. The first part, dealing with the advantages and disadvantages of mini fertilizer plants, including the technical and economic evaluation of the most widely used fertilizers, has been covered in the main in the above study.

The second part, the examination of new mini ammonia plant flowsheets as presented to the Seminar on Mini Fertilizer Plants, including the UNIDO-FEDO basic engineering design for a 100 mtpd ammonia plant, is presented in the draft guide.

The last recommendation of the Seminar concerning the study on storage and utilization of ammonium bicarbonate on soils outside China, could not be carried out by lack of resources.

3. THE ISSUE

The study demonstrates that mini fertilizer plants represent a viable and economic alternative for most developing countries to improve their fertilizer supply position, utilize their raw material resources and provide them with better possibilities of local participation in equipment manufacturing, erection and construction work.

It provides an opportunity for the development of local workshops, skills for maintenance, production of some spare parts and supply of certain engineering services.

Since economic process technology for mini fertilizer plants is readily available but for mini ammonia plants, standardization neither of process flowsheets nor of plant sizes seems necessary. The degree of mini fertilizer plant fabrication in developing countries is expected to be enhanced, since a



number of developing countries have or might have in the medium term, the know-how skills and experience for doing it. This possibility might further strengthen the scope for co-operation among developing countries in the fertilizer industry.

Participants at the Fourth Consultation are thus invited:

(a) to examine the economic feasibility of mini fertilizer plants, and to advise on further steps to be taken by all the parties concerned to develop its potential in developing countries and to provide suitable technical assistance;

(b) to examine the new mini ammonia flowsheets and advise the parties concerned on steps to be taken for the commercial application of some of those flowsheets;

(c) to advise the parties concerned on the testing and/or development of non-conventional fertilizers such as ammonium bicarbonate, non-metallic minerals saving fertilizer and water, and fertilizers suitable for tropical and semi-tropical conditions;

(d) to advise the parties concerned on activities to be taken towards promoting the manufacture of equipment and engineering services for mini fertilizer plants in developing countries, as complement to the capabilities of developed countries in this industry;

(e) to examine the draft guide to mini fertilizer plants and advise UNIDO on its completion;

(f) to advise UNIDO on means to financing this programme including contributions in kind.

