International Fertilizer Industry Association

IFA Technical Conference

Johannesburg, South Africa
30 September-4 October 1996

International Fertilizer Industry Association - Secretariat: 28 rue Marbeuf - 75008 Paris - France
Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

ORGANO-MINERAL FERTILIZERS
A NEW CONCEPT TOWARDS SUSTAINABLE FERTILIZER USE

N. Louizos, Drapetsona Fertilizers
and K. Rettos, Synel S.A.
Greece

RESUME

Les engrais organiques de diverses origines ne peuvent remplacer les engrais minéraux classiques fabriqués chimiquement car les premiers ont une teneur irrégulière et plus basse en éléments nutritifs, cependant que leur transport et leur manutention sont très difficiles. Malgré cela, les engrais organiques sont employés non à cause de leur teneur en NPK, faible en tout cas, mais surtout pour la matière organique humifiée qu'ils contiennent.

En incorporant de la matière organique à des engrais fabriqués chimiquement, on peut obtenir un produit qui offre encore tous les avantages de ce dernier en terme de teneur (produit à haut dosage) et forme (granules faciles à manipuler) qui en même temps conserve les propriétés valables de la matière organique qui enrichit le sol.

Synel, la coopérative agricole de Grèce, produit un engrais organique obtenu à partir de fumier de volaille après fermentation prolongée. Ce produit constitue l'une des matières premières de la production d'engrais NPK comme le 20-10-0, 11-15-15 (S), etc. en une proportion d'environ 20 %. Ainsi, il est possible de remplacer des matériaux essentiellement inertes autrement nécessaires pour la production des engrais ci-dessus par de la matière organique, qui grâce à une fertilisation continue année après année, enrichit le sol et améliore ses propriétés physiques et mécaniques.

On peut définitivement affirmer que cette combinaison est un pas en avant vers une fertilisation durable et peut donc servir de modèle pour d'autres combinaisons semblables.

◆ ◆ ◆

1. INTRODUCTION

The idea of sustainability became once again a top subject for discussion by the end of the eighties based on the work of the so-called Bruntland Committee in Europe. In 1992 the European Commission issued the Programme of Policy and Action in relation to the Environment and Sustainable Development: Towards Sustainability. During the same year the United Nations Conference on Environment and Development in Rio de Janeiro established officially sustainability as the principle which should govern human activities, mainly in the developed countries. According to this principle natural resources should be used in such a way so that they continue to serve forthcoming generations.

Historically agriculture has developed based on the recycling of plant nutrients, in the form of crop residues or manure. However with an increased availability of mineral fertilizers from external sources in the 20th century there was a trend towards the breakdown of traditional nutrient cycling practices on-farm, thus less and less organic material was used in arable production.

The ability to maintain sustainable agriculture over decades and centuries will largely depend on our successful management on recycling plant nutrients as well as proper balancing in the use of mineral and organic fertilizers. Our presentation is aiming at this end and could be considered as an example of such a combination or a step towards sustainability.

2. EXISTING SITUATION IN PRODUCTION AND USE OF ORGANIC FERTILIZERS

Production of organic fertilizers is mainly effected in small scale by processing organic materials such as lignite, agricultural residues, animal residues or biologically active materials which subsequently are mixed with inorganic salts. The product resulting from the above mechanical mixing is in the form of powder or pellets but its main characteristic compared to conventional mineral fertilizers is not only that it is in an inconvenient form for handling-distribution (big volumes, difficult application) but also that it has a very low content of main elements i.e. N, P, K, normally less than 10% in total which results in high transportation and storage cost.

On the other hand from the agronomic point of view it is well known that one of the basic factors for the fertility of the soil is its content in organic material which not only improves the physicochemical characteristics of the soil but also leads to the development of biological processes valuable for the development of plants. The use of soils year after year, under intense fertilization practices, normally and exclusively by means of mineral fertilizers results inevitably to the decrease of organic matter in the soil which in turn leads to all negative consequences on the quantity and quality of agricultural products.

To face the above problem Greek farmers as most probably happen in most other parts of the world, use organic fertilizers in a very small percentage of the arable area and only for limited species of vegetable and fruit plantations, while nothing is done for the big majority of soils and plantations.

It is worthwhile to mention that by using exclusively and continuously mineral fertilizers which in certain cases (16-20-0, 20-10-0, 11-15-15) contain inert material (filler) just to balance the grade, instead of enriching the soil at the end of the cycle one ends up with degrading the soil by adding this inert material.

Last but not least from the environment point of view the diminishing or in any case low use of organic fertilizers not only widens the already "open" nutrient cycle of agricultural systems but also creates environmental problems since all these organic materials if not properly used as fertilizers should be massively disposed i.e. dumped in landfills or introduced into rivers, washed to the sea, etc.

3. ORGANO - MINERAL FERTILIZERS

3.1. Outline of the Innovation

To overcome the disadvantages of organic fertilizers regarding handling and distribution mainly as far as the end user (farmer) is concerned and make it possible to re-introduce them to the farming cycle, one can incorporate organic matter (by different ways) into a chemically manufactured fertilizer, thus leading to a new product the organo-mineral fertilizer. This new product has still all the advantages of the mineral fertilizers in terms of content (high analysis product) and shape (granules easy to handle) but at the same time it maintains the valuable properties of the soil enriching humified organic material. In other words the mineral fertilizer is acting on the carrier of the organic matter. On the other hand in cases where inert material is introduced in the fertilizers as filler the organic material is replacing the filler, so a chemically and agronomically inert material is replaced by a soil enriching material which also contributes to the effectiveness of the final product in terms of macro and micro elements.

3.2. Profile of the Partners

The innovation was developed in the framework of the existing collaboration by SYNEL and Drapetsona Fertilizers. Synel is representing the farmers cooperative in Greece which is distributing more than 60% of the country's fertilizers. Synel also owns and operates a small production plant which is producing about 10000 MT/yr of organic fertilizer obtained from poultry manure after prolonged fermentation, according to the OKADA process. Drapetsona Fertilizers is the ex Hellenic Chemical Products & Fertilizers Co., which is the oldest fertilizer producer in Greece producing about 350.000 MT/yr of conventional mineral fertilizers of various grades such as 16-20-0, 20-10-0, 11-15-15, 15-15-15 etc. by the slurry granulation method or compaction.

3.3. Analysis of the organic material

The organic material to be incorporated in the mineral fertilizer was selected among various other materials since it is relatively rich in macro as well as micro nutrients. It is also sterilized (as sterilization is part of the production process of the organic material) and has acceptable physicochemical characteristics, while heavy metal content is zero to negligible. The typical chemical analysis of the organic material is as follows (%):

Moisture	15-25
Organic matter	70-80
N	3-5
P_2O_5	3-5
K_2O	3-4
CaO	3-4
MgO	1-1.5
Fe	0.5
Zn	0.05
Mn	0.07
B	0.009
pH	8
Humic/Phulbic acids	44

The results of DTA and DTG analysis for organic material correspond to those of the chemical analysis (39% ash, 61% organic matter) and show that the behaviour of the material is very close to that of humic acids and xylite.

3.4. Production Process

Poultry manure is first of all well mixed and homogenized in specially designed mixer within greenhouse-type buildings where it is undergone aerobic fermentation and drying for about 25 days, according to the OKADA process and technology. The temperature obtained (40-70°C) guarantees the production of a sterilized free from pathogens as well as odorless material which is either palletized and directly distributed as organic fertilizer or used as raw material for the production of organomineral fertilizers.

The production of organomineral fertilizers is taking place either in a compaction plant (Figure 1) or in a conventional slurry granulation plant (Figure 2) where the organic material is introduced in the recirculation stream along with other solid raw materials (Ammonium Sulphate, MAP, Potassium Sulphate, etc.) prior to the granulation step. Several industrial scale runs were made with typical Greek market products such on 16-20-0, 20-10-0, 11-15-15 whereby organic matter was introduced at a percentage of 10-20%. The limiting factor for this percentage was keeping the physicochemical characteristics of the produced fertilizer to the quality standards of conventional fertilizers i.e. to ensure good granulation, keep granule size, hardness, abrasion resistance and caking tendency within the accepted limits. The effect of high temperatures (~100-110°C) developed in the granulator, on the stability of the organic matter was checked and found to be insignificant since in the worst case under laboratory scale measurements the loss of material at such temperature due to volatilization did not exceed 20% which in terms of nitrogen corresponds to a loss of ca 15%.

Alternatively the organic material was also used in the production of compacted fertilizer (18-9-6) in a compaction plant where it was fed together with other solid raw materials. In this case the effect of temperature mentioned above is eliminated.

4. CONCLUSIONS

Organo-mineral fertilizers are produced by incorporating organic matter such as poultry manure properly fermented into conventional chemical fertilizers. By controlling the percentage of organic material so that it does not exceed 20%, the final product is equivalent to conventional chemical fertilizers as far as physicochemical and mechanical properties are concerned. However it is superior to them taking into account the humified material by which it is enriching the soil, an advantage which is magnified in case the organic material is substituting fillers used so far in the production of chemical fertilizers. Beyond this it contains low cost macro and micro nutrients of organic origin, no heavy metals and is practically odourless.

Environmental problems due to the inefficient use and poor distribution of nutrients, as well as growing awareness that raw materials for the production of nutrients are not infinite resources, represent a real challenge and opportunities for the fertilizer industry to work with farmers and policy makers and become once more involved in the recycling of nutrients as the basic principle of sustainability imposes. Potential sector for application of this principle is primarily the sector of animal waste which indeed corresponds to a vast nutrient resource.

Beyond this however there are lots of other cases like food industry wastes (Brewery, dairy, meat, starch, sugar, etc.) as well as urban wastes which following current trends for cleaning municipal waste water are creating an ever increasing quantity of recyclable material.

FIGURE 1
COMPACTED FERTILIZERS GRANULATION PLANT

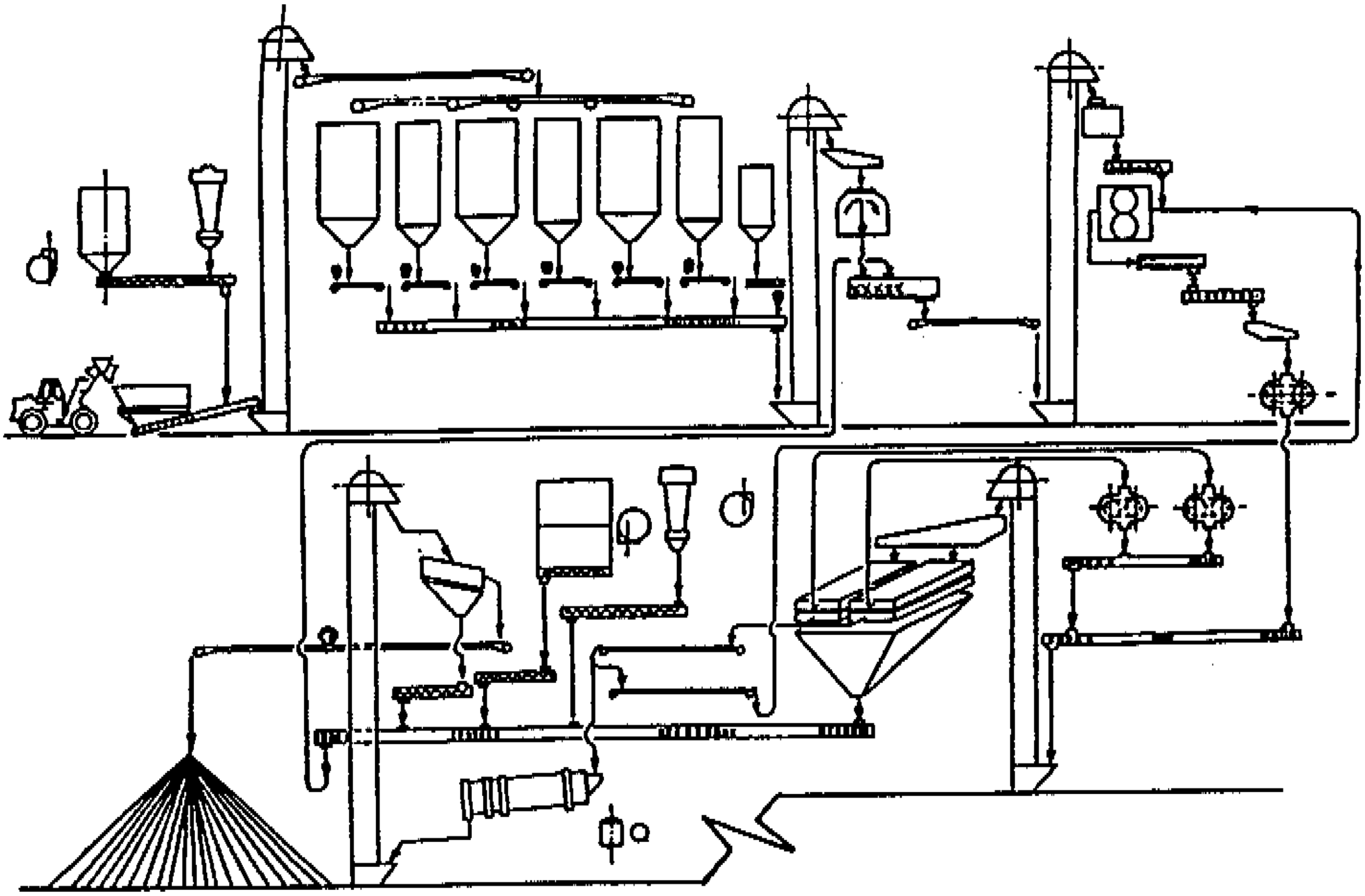

FIGURE 2
CONVENTIONAL GRANULATION PLANT