OCCASION

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

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

OCCASION

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

DISCLAIMER

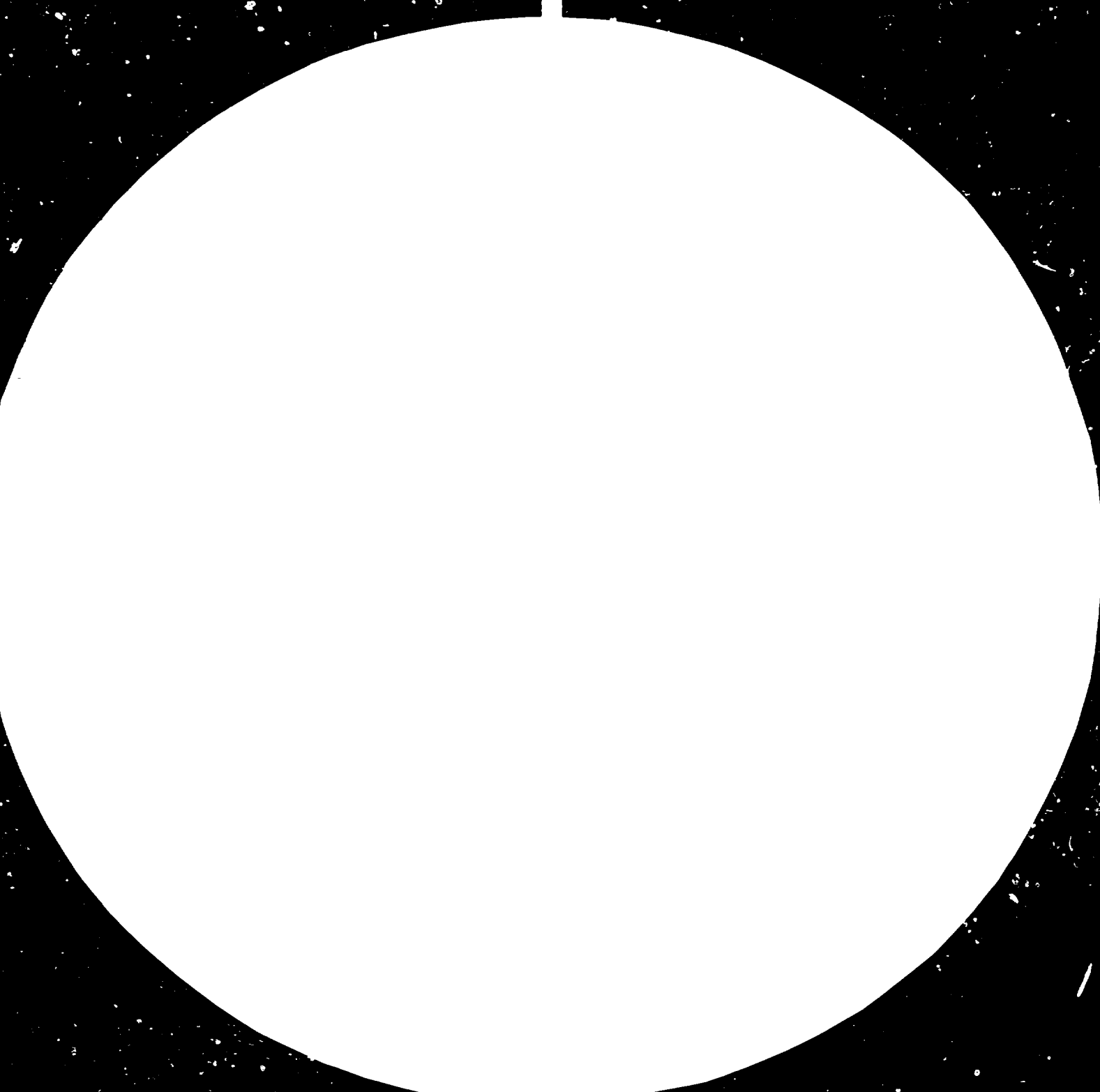
FAIR USE POLICY

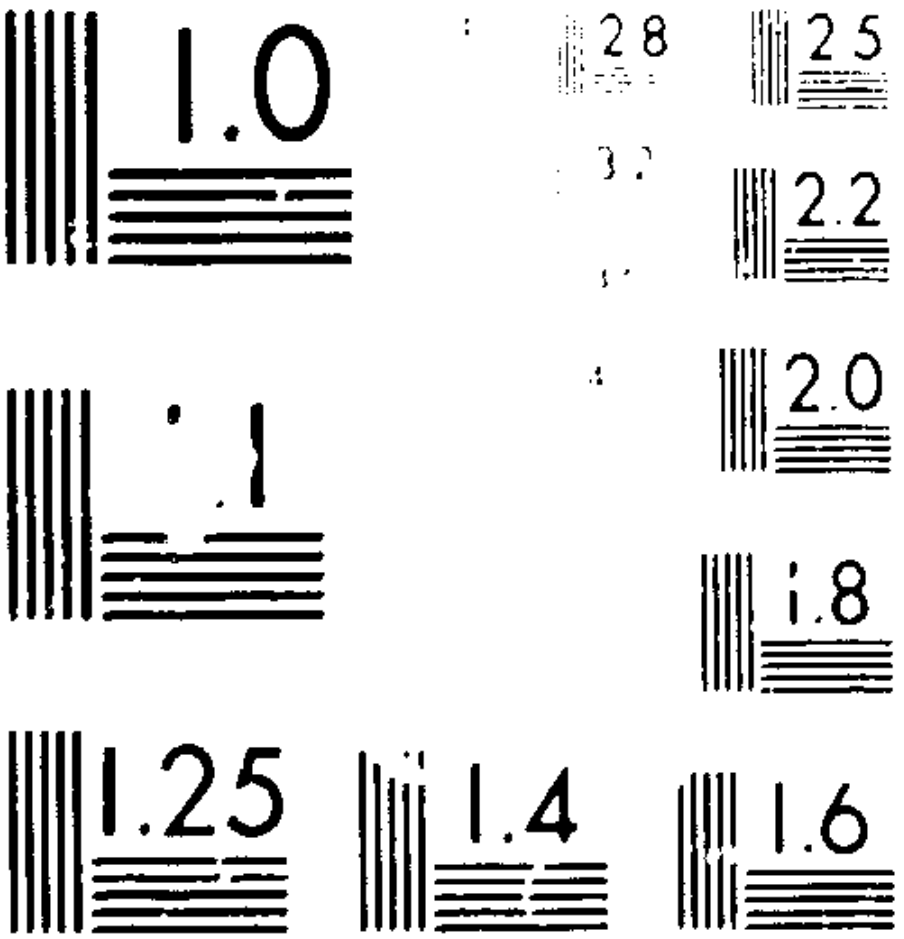
CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org




1.0
2.8
2.5
2.2
2.0
1.8
1.25
1.4
1.6

10668

Distr.
LIMITED

ID/WG.347/9
19 August 1981

ENGLISH

United Nations Industrial Development Organization

Workshop on Cement and Concrete Products
Brisbane, Australia, 18 - 29 May 1981

TRANSPORT AND STORAGE OF CEMENT AND OTHER MATERIALS*

by

J. Peak**

* The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Civil Engineer, Pozzolanic (Qld.) Pty. Ltd.

CONTENTS

Introduction In view of the title of this submission and taking into consideration the subject titles of other speakers in this workshop, the areas chosen for both transport and storage are as follows:

(a.) Raw materials for concrete

(b.) Cement - (Lime)

(c.) Fly Ash

(d.) Admixture

(a.) RAW MATERIAL

The machinery for loading and transport on site serve operations from approx. 600 tonnes/hour crushing capacity down to the smallest of say 20 tonnes/hour. Therefore the market has developed for off road vehicles(quarry haulage trucks) of typical sizes 15, 20, 35, and 50 tonne capacity, ranging in prices up to $400,000 which is a large capital investment and the operators attitude to his job and machine becomes very important.

In this country, where 15 years ago labour costs began to be a more serious consideration it is not difficult to see why, in one particular instance, a well-known company operating a 400 tonnes/hour crushing plant would prefer 2 x 50 tonne units to 8 - 10 old road trucks of 10 tonne capacity for quarry haulage.

The momentum generated by a 50 tonne truck at 35 Kph is considerable, and their ability to stop, handle, and turn is a minor triumph in engineering, but they are still small by comparison with 200 tonne units in the mining industry. These modern quarry trucks are quick, safe and reliable, and have fast tipping cycles.

These must of necessity be matched with suitably sized excavating and loading equipment such as Front End Loaders up to $650,000 or Hydraulic or conventional excavators or drag lines.

Other than supplementary ground stockpiles, no other stockpiling of shot rock is necessary. No doubt we could mention surge piles and recovery tunnels as part of the processing from one stage to the other to facilitate continuity.

Final products of the crushing and screening and sand-winning processes are generally relegated to stockpiles via stockpile conveyors or radial stackers. In less efficient instances, trucks of various sizes move material from minimum capacity product bins to stockpile areas.

The transport of these products generally 40 mm. down to sand sizes is almost exclusively carried out-in open tip trucks in this country, sizes from 10 to 30 tonne capacity. One exception to this is a vehicle known as the FLO-BOY which utlises a semi-tipper configuration with a body section of hopper shape, and an endless chain belt feeding to the rear, not unlike a chain conveyor in a coal mine. Rail ballast is moved over long distances by rail itself e.g. Indian Pacific, Shepherds Hill, N.S.W.

The age old problem is that of accurate measurement and the elimination and solving of disputes between purchaser and the supplier. It is not difficult to realise that monthly, material is still purchased by volume, however, where possible weighbridges are installed. Disputes arise from settlement of material in transit, bulking of sand, lack of proper records of truck body sizes.

Conveyor belt weighers of various capacities and accuracies are introduced, but to date they have been used more to monitor production rates.

(b.) CEMENT

A cursory glance at the cement and lime industry will indicate the uniquely high capital cost involved compared with other products required for raw material or concrete itself. The reserves of suitable limestone are not necessarily situated close to the market place.

We, therefore, in a country of this size have had to develop what we could term an industry of specialised transport and storage facilities to distribute cement.

All forms of pneumatic transport are utilised, namely ship, rail and road, and the storage facilities for the main part are steel silos or concrete installations ranging in capacity from 50 tonnes to 10,000 tonnes.

Bagged Cement

In spite of the sophistication of the Pre-Mixed Concrete Industry, there is still a large demand for bags, generally distributed through local hardware shops and transported by rail, and, or flat top trucks to towns and areas where low volume would not encourage bulk facilities.

Limited use is made of bulker bags of one or two tonne capacity. These are sometimes a compromise for a concrete plant operator producing something less than say 400 m^3/month. There is one in Glen Innes, N.S.W. and no doubt some more. The storage is generally in sheds with some simple arrangement for tipping into a bulk bin as opposed to a silo prior to weigh batching.

Statistics

The following table was compiled from the best figures available. Although the population is the 1979 figure, the percentages obtained would be little different from those if 1980 figures available.

STATE	POPULATION $\times 10^3$	CONCRETE PRODUCTION $m^3 \times 10^3$	m^3/HD	% GROWTH SINCE 1970 m^3
N.S.W. (A.C.T.)	5296	3865	0.73	22%
VIC.	3853	2423	0.63	3%
QLD.	2196	2366	1.08	161%
S.A. & N.T.	1310	989	0.75	29%
W.A.	1242	1044	0.84	16%
TAS.	418	261	0.62	28%
TOTAL AUSTRALIA	14417	10927	0.76	32%

The outstanding highlight of these figures is no doubt the growth rate in Queensland brought about by mining in Central Qld. and tourism on Gold and Sunshine Coast areas, and in North Qld. Queensland is a rather more de-centralised than other states if one cares to study the distribution of population.

Hence there is cement produced in Rockhampton and Townsville as well as Brisbane. The development of the rail system in Queensland has been designed orginially on the concept of a north-south coastal system with three major branches going towards the west - from Brisbane, Rockhampton, and Townsville. Other branch lines to serve coal mining in Central Qld. have recently been developed. On the other hand very few miles of rail have been abandoned in favour of road.

One exception is the link to the Gold Coast, where cement was carted in 5 tonne containers to a rail head and thence to concrete plants and projects in the early 50's. The development was such that the rail became inadequate and uneconomical to upgrade and was demolished from Beenleigh to Coolangatta soon after. Today the demand for bulk cement on the Gold Coast is about 13,000 tonnes/month.

It is not surprising that Government has received applications to establish a terminal on the Brisbane River - for cement shipped by sea from Adelaide.

Some 15 years ago R.M.C. (Ltd.) began to ship cement from Tasmania to a large terminal in Sydney Harbour and also to Melbourne. These terminals are still in operation today.

All of the bulk cement in Darwin comes by ship from either Japan, Korea, Taiwan, or Germany to a bulk facility on the Harbour. This is a more recent inovation - since about 1969. Prior to this, Burns Philp imported bagged cement, and it was de-bagged and transported to local concrete producers in their own agitator trucks and screwed out into the receiving hopper of a Fowler Rex Silo with bucket elevator.

The next development was to de-bag into a single pressure pot (by Interconsult) and then blow into a similar one on a truck for delivery and pressurised into the silos.

Bulk Cement

No doubt with the introduction of ship loads of cement, problems arose with stocktaking. It was not uncommon for the town to run out of cement. This did offer the opportunity for the merchant to consider his stock situation.

One of the interesting aspects was that this ship delivered some portion of its cement cargo to the Gove project and the quantities were determined by ship survey. The silo used there is now in use in Brisbane and is large by comparison with others - 650 tonnes capacity of cement.

In Queensland, large storage facilities are non existent except for the actual cement works themselves.

The standard silos at concrete plants are no larger in capacity than 80 tonnes and then generally there is only one, and so the transport system needs to be fast and efficient.

Road transport using tankers similar to that shown on the Pozzolanic Brochure deliver all the cement in S.E. Qld., south of Maryborough in legal loads of abour 24 tonnes each, at a freight rate of abour 7¢ or 8¢ per tonne per Km.

Further north, there are various private enterprise companies with facilities on rail to supply up to Cairns and mining centres of Mt. Isa and the coal fields of Central Queensland.

In most instances cement is blown directly from the rail wagons at a designated siding, into road trucks for local delivery. In fewer instances such as Goondiwindi and Mackay the concrete plant is located adjacent to the rail.
In N.S.W. there are isolated terminals in Lismore and Tamworth.

One other aspect of cement useage is that for Road Stabilisation projects. Some are large jobs involving 200 to 400 tonnes and some are located in relatively remote areas and the timing of deliveries is critical.

If rail is used, then the wagons themselves constitute storage facilities as close to the site as possible hopefully without demurage.

If road transport is used, then often an extra tanker can be parked at the site. This and the capacity of the spreader itself act as storage.

In the same way that cement is pressurised in and blown into bulk silos so also can Fly Ash without any suggestion of contamination or need for cleaning of tankers between loads.

The unit weight of Fly Ash is somewhat less that that of cement and therefore as a denser criteria, Pozzolanic tankers have the capacity to haul fully legal loads of Fly ash. This means that when cement is hauled the tanker is only part full.

Materials to be transported in pneumatic tanks fall into two categories:-

A. Cement, fly ash, hydrated lime, agricultural lime, grain, dry fine sand.

   These can be alternated without fear of contamination.

B. Quick lime, planter, flour and gypsum - need special considerations

There are some special details and considerations in bulk handling arrangements -

Axle Road Limits - considering the variation in unit weights of material likely to be moved and the fact that tankers sometimes mover interstate. Tankers are designed as pressure vessels complying with state regulations.

Silo length and diameter for transport.

Power Blowers on the truck are generally powered via P.T.O. from the truck motor. However, it could be advantageous to have a separate unit powered by an internal combustion motor (Holden). If this is by electricity, deliveries to remote areas may not be possible.

Filters Pollution control is a special consideration. The volume of air required at low pressure (15 - 18 psi) is many times the volume of the actual material, and therefore needs to be dissipated without contamination to the environment through special filters on top of silos, or vent pipes to ground level filters. The cost of these is up to $1500 approx.

Air Slides and Screws are devices to move cement or Fly ash for batching but are not recommended for metering accurately.

Air It is important to have sufficient supply of dry compressed air (as opposed to the L.P. air for blowing) to be able to have air slides and valves and gates working efficeintly. The lower section of the cone of silos requires aerating to enhance continuity of flow when batching.

"Vackonveyor" is an automatic vacuum/pressure pot of small capacity 200 Kg. Fly ash designed to handle dry powdered material with bulk densities of 60 to 160lb/cubic foot. It automatically fills and discharges drawing from a hopper or silo from whence the material can gravitate to a truck or directly from a silo to a truck.

The rate of conveying depends on the material and the height or static lead, but 20 tonnes/hour of fly ash over 50 ft. is achievable.

Some of the Budget Costs for equipment used in pneumatic handling and storage are as follows - in Aust currency:-

Prime Mover	-	$75,000 to $90,000
Tanker	-	$45,000
Blowers	-	$ 3,000 (+ drive)
Compressor(35 psi)	-	$ 4,000 (+ drive)
Holden Motor	-	$ 1,000
Rail Wagon (40 t)	-	$38,000 (Q.G.R. rolling stock)
Complete wagon(40t)	-	$70,000 max. gross 63 tonnes.

N.B. N.S.W. Railways 4' 8½" c.f. Qld. 3' 6" and allow max, gross of approx. 80 tonnes giving 58 tonnes nett.

Silo - 80 t cement (or 50 t fly ash) - $17,000 ex works

120 t cement (or 100 t fly ash) - $24,000 " "

LIME

As mentioned previously all forms of Lime can be conveyed pneumatically and road transport plays a vital role in the rather small quantities required in S.E. Qld. Quick lime and hydrated lime are available some 500 miles away at Rockhampton and Tamworth N.S.W. and the local uses are largely in water treatment, sugar mills, and road stabilisation in black soil country.

(c.) FLY ASH

Large quantities are used in Queensland as indicated by a previous speaker.

This material is available from Swanbank Power House in Ipswich and Gladstone, and is distributed from Murwillumbah to Cairns and the Atherton Tableland and developing areas of C.Q. aud Darling Downs.

Because of the proliferation of concrete plants the storage in total afforded by tnese in Brisbane could be as high as 4,000 tonnes. The unit weight being approx. 55 lbs./ft^3 allows only 50 tonnes of fly ash in a standard 80 tonne cement silo.

At Swanbank, the ash is stored in silos of various capacities totalling about 800 tonnes. The ash is drawn from hoppers underneath electrostatic precipitators by air slide and low pressure 20 psi blowers convey it to storage - thence by gravity into trucks.

Auxiliary storage of 10 x 100 tonne silos have recently been erected close by where two of these are high level for loading trucks and vackonveyors are used to lift the ash from the other 8 silos when required.

All ash from Swanbank is transported by road transport and tare weights are determined either at a weigh bridge at the Power House or on the M.R.D. Bridges.

Fly Ash from Gladstone finds its way to North Qld. by rail and to Melbourne in 2 tonne bulker bags by road.

Some back loading of cement can be effected on the rail from Townsville and by road between Rockhampton and Gladstone.

Storage of large quantities of cement or Fly Ash appears not to have been tackled in this country other than shipping terminals. There is a proposal to erect an igloo shaped building founded on concrete with low parapet walls similar to some in the U.S. to store 12,000 tonnes and use a loader with a totally enclosed cab to recover the material.

(d.) ADMIXTURE

Most concrete in Australia does contain some form of Admixture, be it water reducing set retarder or accelerator, air entraining agent, calcium chloride, or super plasticiser.

Common dose rates for these vary from-0.5 litre to 2 litres per m^3 of concrete.

This leads to a small storage facility at each concrete plant, of say 2300 - 4000 litres capacity supplemented by drums of A.E.A. or smaller bulk facilities.

Steel tanks are commonly used and in some instances fibreglass. The chemical is highly corrosive and leads to rapid rates of depreciation. A 2300 litre tank costs approx. $800. Transport in bulk delivery tanks of say 2300 litre capacity would cost 2¢ to 4¢ per litre locally in tanks costing $2000 each.

Holding tanks at the factory depending on the scale of operation would be up to 20,000 litres.

CONCLUSION

On behalf of my Company - Pozzolanic (Queensland) Pty Ltd I wish to express our thanks to the Dept. for the opportunity to be involved in U.N.I.D.O.

If there are any queries unanswer d during this session please do not hesitate to contact this company.

ACKNOWLEDGEMENTS.

Hastings Deering - Slides and literature

Forbes Engineering - Literature

Qld. Weighing Machines - Literature

Pozzolanic Australia - Slides and Literature