BELTCON 7

POSSIBLE TRENDS IN BELT CONVEYOR TECHNOLOGY

Mr R Fauerbach, Joint Managing Director,
Krupp South Africa (SA)

IMHC

INTERNATIONAL MATERIALS HANDLING CONFERENCES

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DEVELOPMENT TRENDS

OF

LARGE CONVEYORS

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1. WHAT IS A LARGE CONVEYOR?

The prophets have all died!

The psychics of the sixties have disappointed us all and are only capable of sketching scenarios.

Nobody knows what the future holds.

I can assure you of one thing however, that there will definitely still be conveyors in the future, the larger the better.

My paper here, deals with large conveyors in the mining and bulk materials handling fields, ie, with belt widths exceeding 1 meter and belt lengths in excess of 1 kilometre.

I cannot tell you of visions of streamlined conveyor shapes, operated on by 'white collar' engineers on clean computer screens only. I can only serve you with some simple down-to-earth ideas.

2. THE PAST IS STILL PRESENT

The development history of modern technology always shows a number of successive trends/phases, such as :

- the emergence of new technology;
- the start of competitiveness;
- the attempted improvement of older technologies;
- disadvantages and advantages becoming clear;
- the establishment of old and new technologies in the most advantageous areas;
- old and new technologies supplementing one another.

We all observed these phases when digital wrist watches made their appearance; also when television was discovered and everybody believed that the cinema would have no future!

The same applied in the development of large conveyors. Yet, they have supplanted neither the railways, nor the trucks.

The development of large belt conveyors began in the early sixties when the regular railways could no longer cope with the capacities put out by the Rheinische Braunkohlenwerke in Germany.

The capacities rapidly developed - roughly :

PERIOD	CAPACITY m^3/d	BELT WIDTH m	BELT SPEED m/sec
1960 - 1970	60'000	1,8	5,4
1971 - 1980	100'000	2,2	6,5
1981 - 1990	290'000	3,0	6,5
1991 - present	240'000	2,8	7,5

New capacities have been realized with the new steelcord belts and their vulcanized connections; pulleys with flexible taper locks and turbine shells; walking pads and transport crawlers for the heavy head stations; and the shifting technology observed from the railway systems.

This rapid development created an absolute euphoria : in the late sixties Krupp built a 100km long conveyor system in the Spanish Sahara (the longest in the world to date).

The increasing demand in iron ore for steel plants along the banks of the Rhine River created the idea of running a conveyor system from the ore terminal at Rotterdam on the North Sea coast, to Duisburg in the Ruhr area, Germany - some 1'200 km away.

Railway stations were improved : still in the seventies, a 25 km long railway line was built from Hambach to the connected lines for the haulage of lignite. Krupp contributed to this development with a 6m wide conveyor for the train unloader.

New developments began taking place, such as :

- Pipe Conveyors	for	Process Plants	: PHB Weserhütte
- Curved Conveyors	for	Overland Haulage	: Beumer/REI
- Steep Angle Conveyors	for	Inclined Haulage	: Continental Conveyors
- Pocket Belts	for	Shafts, Shipunloaders	: Flexowell

Not one of these new designs however, changed the general concept of the large conveyors though they did settle into the market niches.

The biggest hurdle was that the extreme high costs couldn't be justified. All further ideas for intermediate drives such as

- driving the conveyor rolls
- linear motor drives
- individual clamp drives

didn't perform. They didn't even feature in the market place. The only drive which was built to some extent was the TT Drive. However, even after a performance rated 'not bad', it still did not realize the hopes that had been put into it.

It boils down to the fact that we basically live with the same concept as in the past.

3. Conveyor vs Truck

There are two areas in which the market development of large conveyors received a major boost :

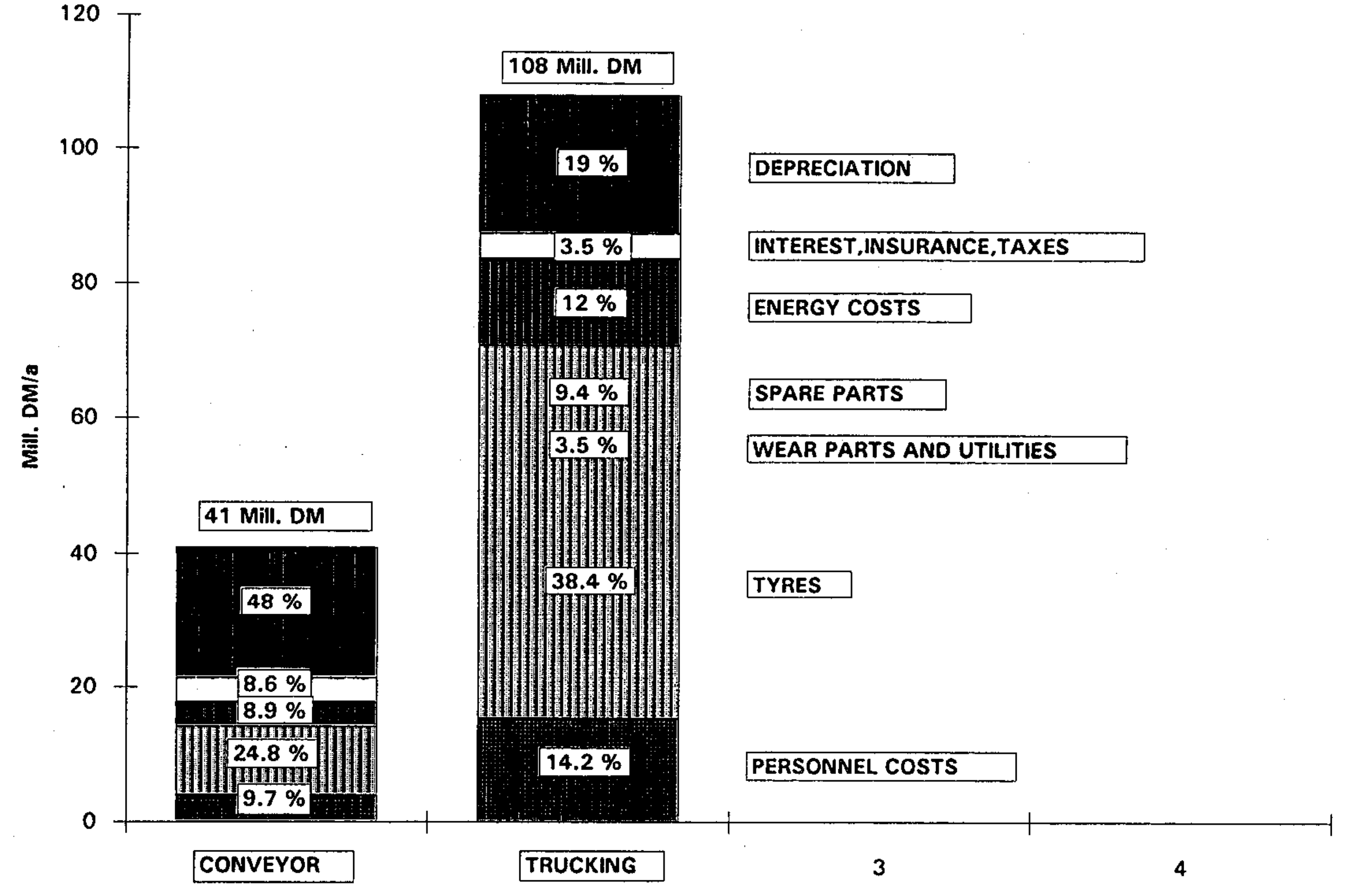
- The worldwide "conveyorisation" of the "soft" lignite mines in the sixties and seventies, due to the inflexibility and the costs of railbound haulage, prominent in countries such as : West Germany, Greece, Poland, India, Australia and Canada;

- The "conveyorisation" of the "hard" rock mines in the seventies and eighties after the emergence of semi mobile in-pit crushing systems, due to cost increases of truck haulage over long distances and depth of haulage, in countries such as : South Africa, USA, Canada, Chile, Australia, Thailand, etc.

Since 1975 an increasing number of these plants have been built.

These so-called in-pit crushing systems do not fully substitute the truck operations, in fact, both haulage systems supplement one another with the advantages : short flexible distances for trucks, long steep distances for conveyors. The reasons can easily be seen in the following graph which is a comparison of the operating costs of : an in-pit crushing system with spreader, transport crawler and 12 trucks (A); and a truck transport system with 54 trucks but without additional equipment (B) :

[I am of the firm belief that this development will continue.]



KRUPP

Cost comparison In-pit Crushing system

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4. Linear Development

As confessed earlier, I admit, I do not have visions of futuristic shaped conveyors. I simply believe that large belt conveyors will remain of the same conceptual design, and will evolve in a linear manner.

History shows that development proceeds stepwise and eventually reaches a level where the steps become flatter and are realized less often.

Large conveyors have reached such immense proportions making further development seem unthinkable, mainly though, for financial reasons. On the one hand this is due to sizes & weights (pulley weight without drive: some 27 tons); and costs (especially belts, ie, a 3m St 6300) which have pushed the prices up to mammoth cost levels.

For higher capacities or lower costs I thus foresee two development trends :

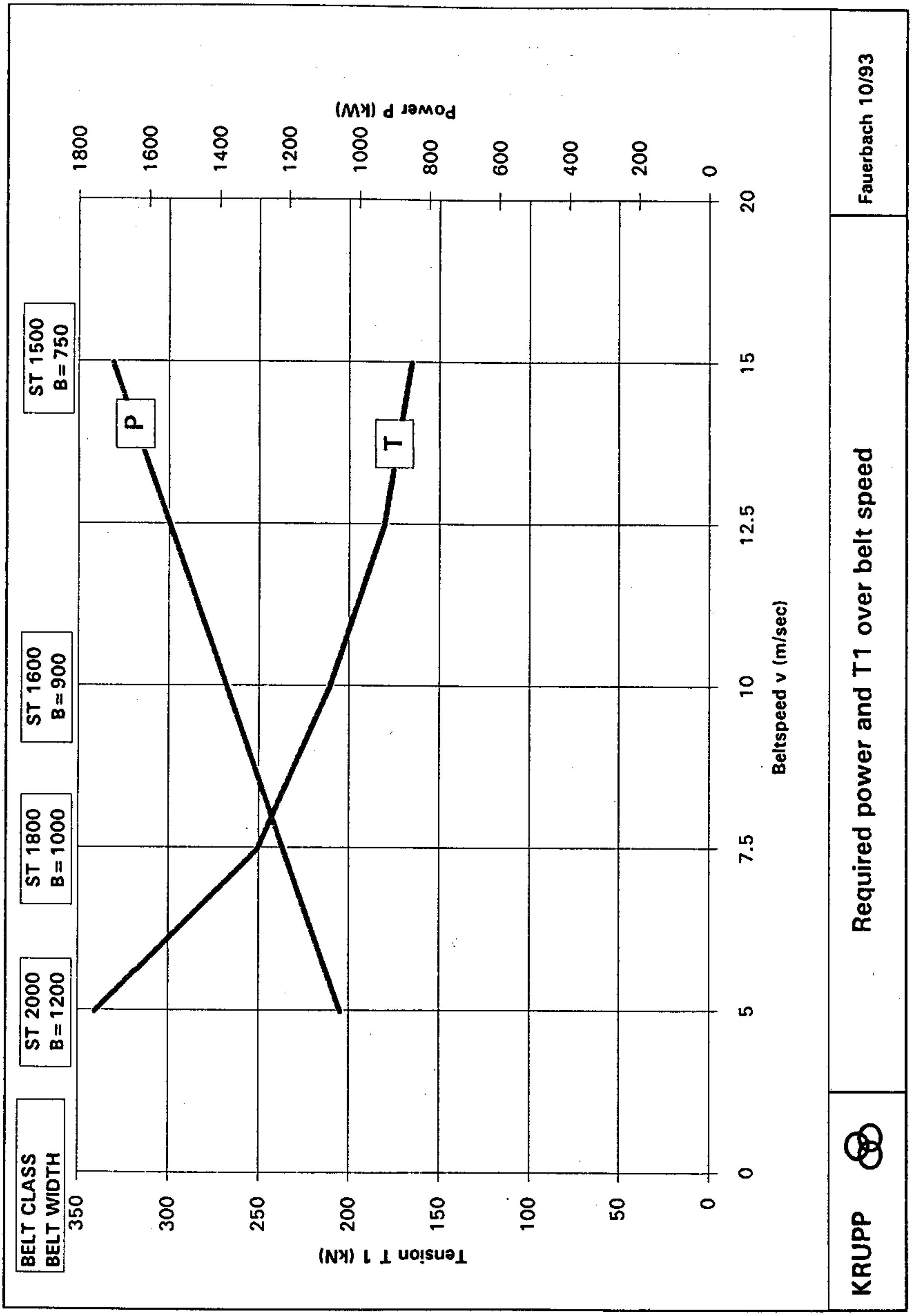
- the increase of belt speeds
- a reduction of downtimes.

Neither trend necessarily means the increase of investment or operating costs.

4.1 Increase of Belt Speed

Most conveyor belts here in South Africa, and elsewhere in the world, run at speeds of up to 4,2m/sec, whereas the common belt speed of large conveyors in Germany is up to 7,5m/sec. Then again, speeds of 7,5m/sec, up to 15m/sec, are reached without major problems in conveyors of similar size in large Spreaders. The reason is simple, as the following graph shows. The example is of a coal conveyor system for 2'000t/h at a length of 5'000m :

USER NAME : EB
BANNER : LST:



With the increase in speed the belt tension is reduced and thus the belt class; as is the pulley torque, gear reducer output torque and ratio - all factors which ultimately reduce investment costs.

Problems are created when the material moved is degraded at the transfer points. A large amount of research and development is required in this area.

We are in need of knowledge in respect of :

- the dynamic behaviour of parts in the material stream of de- & acceleration, and changes in direction;
- the internal material degradation within the stream and on the chute walls at various speeds;
- the modelling of chutes;
- the influence of various chute materials as to the behaviour of flow;
- ETCETERA!

4.2 Reduction of Downtimes

In the sixties a new generation of big scale machines for the German lignite mines emerged. It was proved that the capacity of machines of similar size, weight and thus investment costs could be increased by as much as 25% simply be reducing the downtimes.

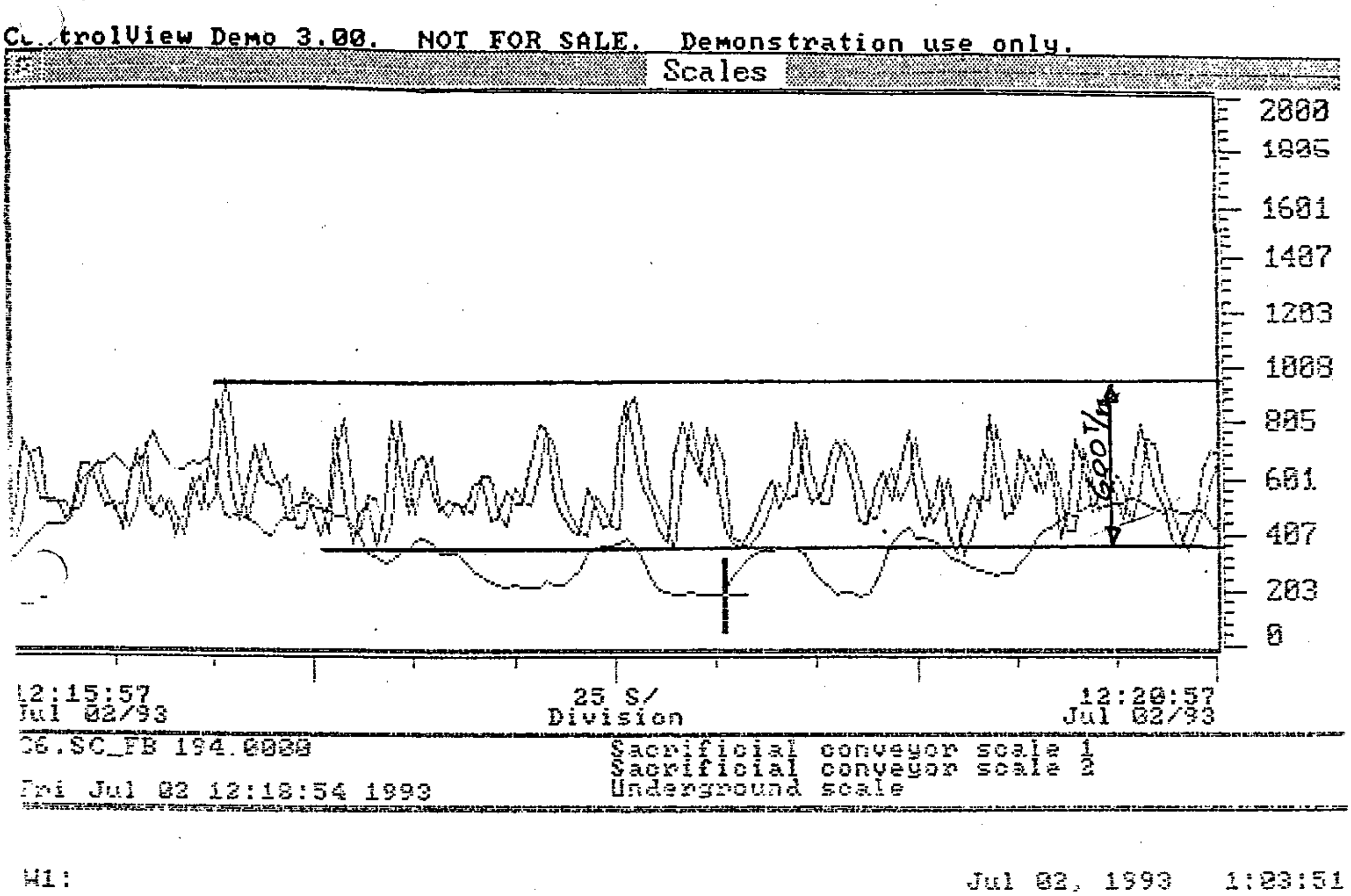
Easy to say - difficult to do!

The maximum utility of the capacity of conveyors will be achieved in three areas :

- material flow
- equipment
- control.

4.2.1 Material - Equalized Material Flow

The following graph shows the load variation of the flow of material onto an overland conveyor system from an apron feeder. The avalanching feed varies within a range of ±30%, meaning that on average, the conveyor can only be utilized at 60% of its capacity:



4.2.2 Material - Preparation

The proper sizing by crushers and bedding of material, as well as dewatering, is often required in order to utilize the full expanse of a conveyor belt within short load variations.

4.2.3 Material - Buffering

For load variations in longer terms via means of silos and stockyards to unify the belt load.

4.2.4 Equipment - Standardisation of Exchange Parts

Much to my surprise, I have not found a significant amount of standardisation of exchange parts in tenders and/or orders in the South African industry in the field discussed. Even the very common parts such as idlers, pulleys, motors, couplings, gear ratios and the like are not standardized inhouse. This reduces the availability of exchange parts considerably and increases the stocking of spares.

4.2.5 Equipment - Simplification of Parts Exchange

The failure of equipment parts frequently creates considerable delays. Various possibilities exist to minimize the downtime for repair work, such as :

- idlers	- exchange during operation by the quick release of garland idlers and idler exchange apparatus
- pulleys	- devices which ease the exchange of heavy and not easily accessible pulleys
- drives	- the use of drive units which can be quickly disconnected without removal
- less heavy equipment	- pulleys without through-going shafts and lighter planetary gearboxes

5. What can we expect?

I have tried to show you ways and means of increasing the capabilities of large conveyor plants, or of reducing investments, such as :

- the increasing of belt speed
- the minimising of downtimes
- the higher utility of the plants.

The widest progress will be made in computer aided operation and computer aided control/supervision of equipment.

Today we monitor the wear of large bearings ***inside the bearing*** during operation. This is possible with pulley bearings, gearboxes and the like. Research is still being done however, to identify and locate blocked idlers by the heat they create on belt friction.

These are typical examples of the development to be expected in the near future.