

Tadipatri's big sixer

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In 2005, Loesche GmbH undertook consistent development of the modular system, designed and patented by the company in the 1960s (see Figure 2), to keep up with the increasing demands of the cement industry for ever-larger production units. In this way, Loesche can provide mill dimensions which are adapted to cope with the throughputs of modern kilns.

A significant aspect of this development was the limitation of the dynamic forces generated during grinding operations by the upwards and downwards movement of the grinding rollers, which can be compared to a car tyre on an uneven road, so that the known operational safety associated with Loesche mills could still be guaranteed at larger mill sizes with nominal throughputs of more than 1000tph.

The smooth production start of the largest Loesche mill ever built has confirmed the correctness of this development direction. The six-roller Loesche mill of type LM 69.6 has an outside grinding track diameter of 6.9m.

The constant demand for higher mill throughput has been the essential challenge for Loesche through its 100+ year history. Only two-roller mills were built during the first decades of the company's existence. The introduction of the roller module system over 30 years ago resulted in new flexibility for mill design. A different number of grinding rollers with the same dimension can be arranged around the central grinding table depending on the mill capacity. Pedestals providing individual bearing and support for the grinding rollers permitted the design of mills with two, three and four grinding rollers. There is no need for an additional supporting frame to brace the rollers to each other inside the mill.

The first six-roller Loesche mill for grinding cement raw material was successfully put into operation in July 2008 (see Figure 1). The grinding plant is part of the new production line in the Tadipatri works of the second largest cement manufacturer in India, Grasim Industries Ltd, Mumbai and its subsidiary UltraTech Cement Ltd. Around 16,000t of cement raw material must be ground every day to supply the new kiln which has a cement clinker capacity of 10,000tph.

The design of mill model LM 63.4 in the mid-1990s, which had an arrangement of four grinding rollers on a grinding track of $\phi 6.3\text{m}$, was the next logical step according to company philosophy. This facilitated the achievement of a nominal throughput of 800tph, based on a medium hardness of cement raw material and a product fineness of 15 per cent R0.09.

The weight of one roller module from

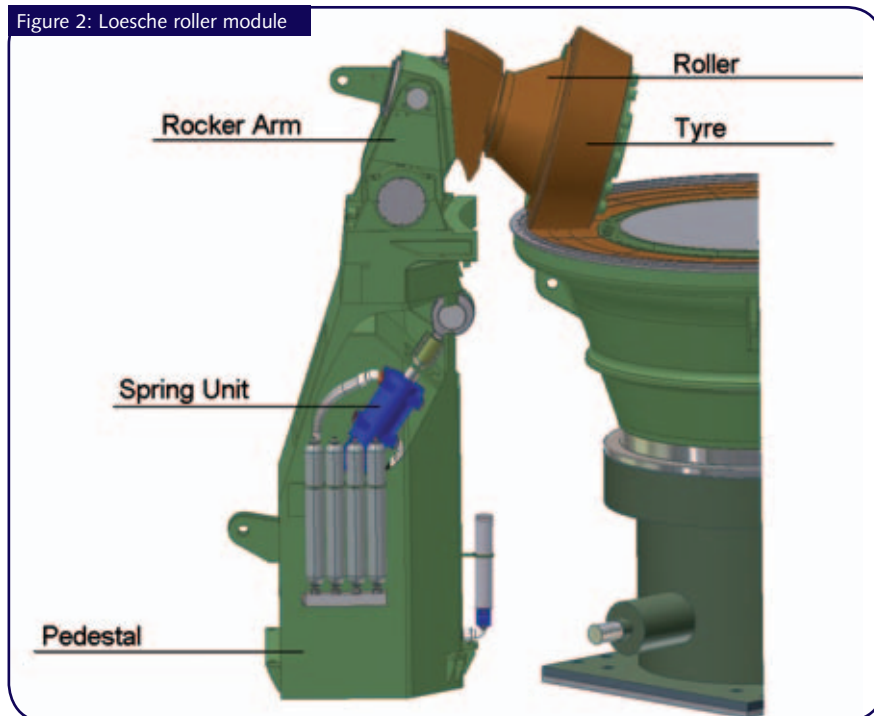
this LM 63.4, consisting of grinding roller and rocker arm, was already around 90t. The dynamic forces resulting from the movement of this mass during milling operations essentially have an impact on the mill structure, on the mill gearbox that supports the grinding table and on the mill foundation. This challenge required a rigid design to ensure the longevity of the Loesche mill.

The decisive step for achieving



Figure 1: LM 69.6 Tadipatri cement works

Figure 2: Loesche roller module



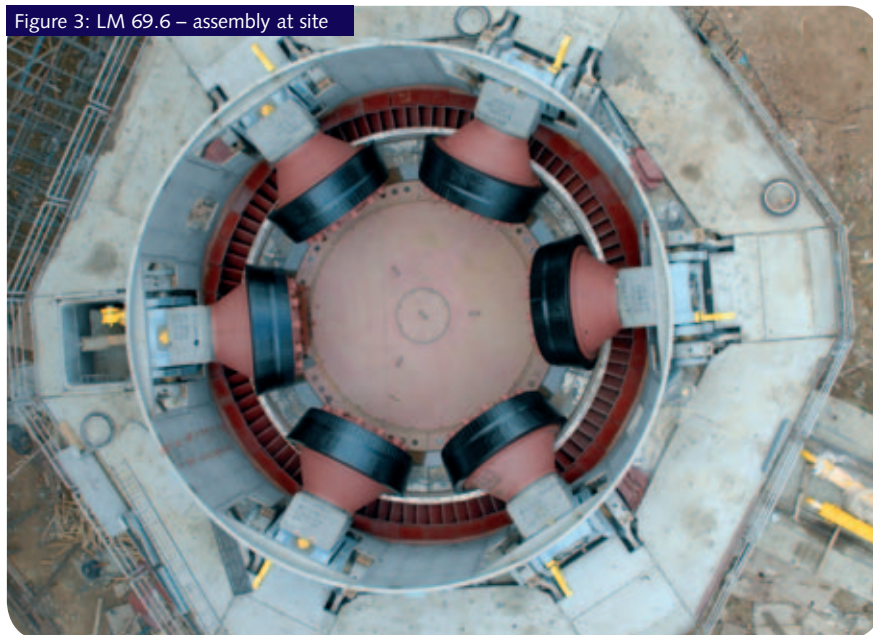
The handling of components during replacement or servicing work is simplified owing to reduced individual weights. The required mill foundation mass is also clearly reduced owing to the lower individual roller weight compared to a four- or three-roller mill with equivalent throughput (see Figure 5). As of today, orders have already been taken for over 15 of these new six-roller Loesche mills.

Commissioning of the LM 69.6 in the Tadipatri cement works took place as expected. After adjusting of the machine settings and stabilisation the guaranteed throughput was achieved in less than 50 operating hours (see Figure 6).

The guaranteed throughput is related to the grindability of the cement raw material used in the plant. Grindability tests in the *Loesche Technical Center* during the project planning phase in 2006 had revealed that the grindability from Tadipatri is very low and at only approximately 50 per cent compared to other raw materials and consequently requires a high specific grinding power of approximately 11.5kWh/t (see Figure 7).

As can be seen from this diagram, the cement raw material from Tadipatri represents a clear exception to raw materials otherwise used. It was necessary to pay special attention to this feature when sizing and designing the Loesche mill and additionally to ensure that both the required comminution force and the smoothness of running of the mill lie within known empirical values. This enables the dynamic forces to the affected components and the mill foundations resulting from the grinding process to adjust to within the specified limit values. Unacceptable forces are thereby avoided.

Figure 3: LM 69.6 – assembly at site



yet greater performance units was to increase the number of grinding rollers, which makes it possible to control the dynamic forces resulting from the grinding operation. This option was chosen instead of increasing the size of the rollers, which would also have caused an increase in the roller mass. The Loesche modular system could be regarded as the crucial element in this scale-up.

Recourse was made to the experiences from the transfer from two-rollers to three or from three-rollers to four, when increasing the number of rollers to six (see Figure 3). Additional advantages of this concept resulted from the possibility

to install roller modules that had already been in operation in the four-roller arrangement. This excluded the risks to the operational reliability of the grinding plant associated with the failure of newly developed sizes of grinding roller. Similarly, the six-roller arrangement permits greater partial load operation of the mill, in which two or four rollers may be swung out (see Figure 4).

Figure 4: four-roller mode of LM 69.6 for partial load conditions and six-roller mode for full operation

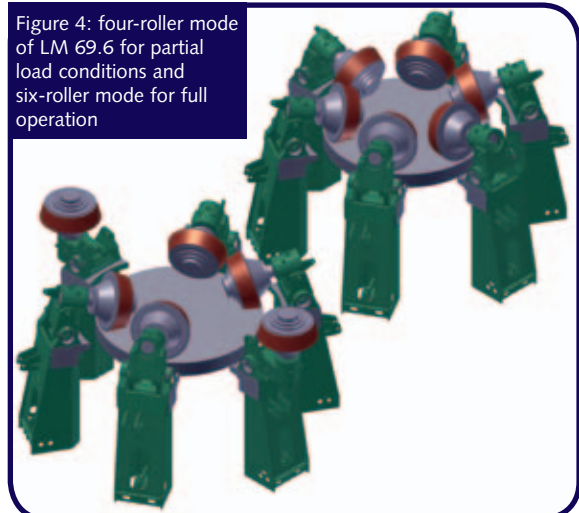
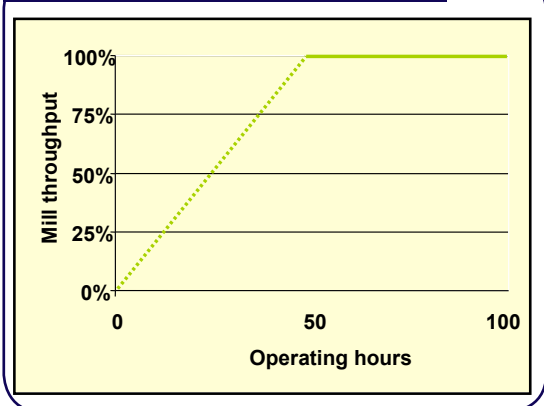


Figure 5: comparison of roller sizes

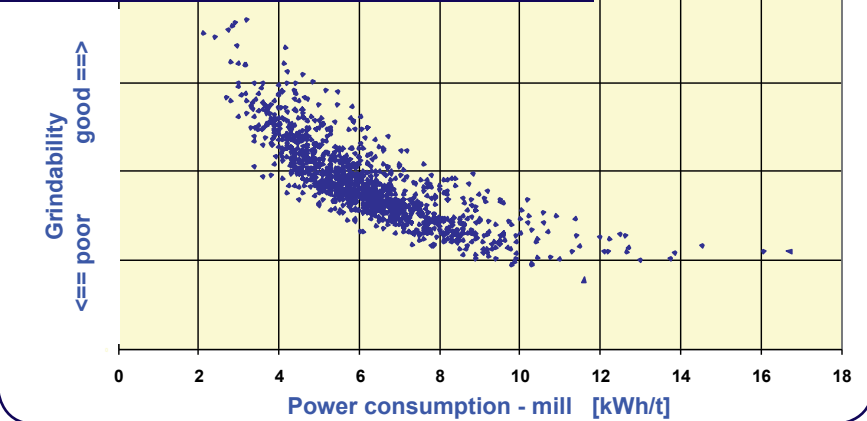


Figure 6: start-up of LM 69.6 at Tadipatri plant



cement works in the Rajasthan province in India. For reasons of better grindability of the cement raw material, only one Model LM 69.6 Loesche mill will be installed in the Kot Putli works for the rotary kiln capacity of 10,000tpd, which is currently being assembled. An identically constructed version with two cement raw material mills was chosen for the new cement line in the

Figure 7: range of grindability of cement raw materials worldwide



The values represented in Table 1 indicate the throughput of the mill, the fineness of the raw meal and the necessary specific power consumption. All guaranteed values were achieved. Further optimisations to boost the energy efficiency of the grinding plant are planned in close cooperation with the customer.

To be able to grind the required mass of approximately 16,000tpd of raw material for the rotary kiln with a capacity of 10,000tpd clinker, two LM 69.6 Loesche mills will be installed in parallel in the full expansion stage of the new line and will produce at least 840tph of raw mix. The second mill is currently under construction (see Figures 8 and 9).

Grasim Industries Ltd ordered further Loesche mills of type LM 69.6 in 2006 for the extension of the Aditya and Kot Putli

Aditya works. The first LM 69.6 was also successfully put into operation in these works in September 2008. The guaranteed throughput of 550tph was achieved after just 20 operating hours.

Furthermore, Loesche mills will also be installed in the new production lines of all three works of Grasim Industries Ltd and its subsidiary UltraTech Cement Ltd to grind coal/petcoke to fire the rotary kilns and for finish grinding of the cement.

The Loesche coal mill, type LM 43.4D, with an outside grinding track diameter of 4.3m, a motor power of 1600kW and a nominal capacity based on hard coal grindability and a fineness of 15 per cent R0.09 of approximately 200tph are the largest vertical roller mills in the world for coal pulverisation. The LM 43.4Ds coal mills are already producing the required coal dust in both the Tadipatri works and the Aditya works. The commissioning of these likewise newly developed Loesche mills, in which a four-roller arrangement was realised for the first time, also took place without any problems and completely satisfied the expectations of operator and manufacturer.

In each of the three works, two Loesche mills, type LM 53.3+3 CS, will be installed for finish grinding of various types of cement. They have a grinding table of ϕ 5.3m, the patented Loesche grinding system, consisting of three pairs of preparation and comminution rollers each and a motor capacity of 4000kW. These vertical mills are still in the construction phase.

A decisive factor when the contract was awarded was the 'unification concept' applied by Loesche to the mills for cement raw material and cement grinding. Here identical components such as grinding rollers, rocker arms for transmission of the spring force onto the rollers, roller bearings and main components of the hydro-pneumatic suspension spring systems such as cylinders and accumulators were used in the mills

Table 1: operational data of LM 69.6

LM 69.6	Plant Guaranteed	Tadipatri Achieved
Mill throughput (tph)	420	430
Fineness	20 %R0.09	17-21 %R0.09
Feed moisture (%)	<7	<2
Product moisture (%)	<1	-
Specific power consumption (kWh/t) (mill, fan, classifier, aux)	25.84	22 (mill motor and fan only)

and facilitate improved spares inventory and supply because these parts are interchangeable.

All in all, the new cement lines of the three works used 54 identical roller modules (see Figure 2) installed in the five LM 69.6 and eight LM 53.3+3 CS Loesche mills.

Conclusion

The successful commissioning of the first six-roller Loesche mills has justified the selected development concept, in which the grinding capacities of Loesche mills were boosted by increasing the number of rollers rather than the roller size/mass. The use of roller modules tested in practice in four-roller mills made it possible to rule out potential development risk to dynamically loaded components. The modules so far installed in the largest six-roller Loesche mills are only medium-sized. Other module sizes, right through to the largest from the LM 63.4, are available and have been in use for years in the comminution of cement raw material. This means that further increases in performance can also be realised in the future insofar as these are demanded by the industry.

Figure 8: LM 69.6 under erection



Figure 9: mill table of LM 69.6 arriving at site (in upside down position for safe transportation)

