

## Smelting: Four-Day Indirect Method

There were two different methods of operating a *tatara* furnace: a three-day “direct” method (*mikka-oshi* or *kera-oshi*) and a four-day “indirect” method (*yokka-oshi* or *zuku-oshi*). In both cases, the inner walls of the furnace gradually melted during operation, and the furnace had to be rebuilt each time iron was smelted.

The four-day indirect method was the dominant method of iron production during the eighteenth and nineteenth centuries. It used a type of iron sand called *akome*, which is taken from rock that is rich in iron and magnesium with high levels of titanium and other impurities. As smelting progressed, molten pig iron oozed out through holes in the bottom of the furnace. Once cooled, the pig iron was collected and taken to the *ōkajiba* forge for refining.

An example of the indirect method can be found in the records of Ataidani Ironworks (Gōtsu, Shimane Prefecture). A single operation of the furnace in 1889 consumed 18 metric tons of *akome* iron sand and 18 metric tons of charcoal to produce 4.8 metric tons of pig iron. Of the iron sand used, only 27 percent was converted to usable products; the rest became slag. As evidenced by this record, the indirect method was not as efficient as the three-day direct method that later replaced it.