Oil/Air Lubrication for Steelmaking Equipment Bearings

T. MIYACHI

Recently, oil/air lubrication has undergone an expansion as a bearing lubrication method used in steelmaking equipment, such as continuous casting equipment. This type of lubrication is attracting more and more customers as it contributes to energy saving through reduced consumption of lubricant and low torque, and, in addition, it supplies compressed air to the bearing to prevent infiltration of foreign matter, and utilizes high viscous oil which can extend the life of the bearing.

We JTEKT have utilized our expertise as a bearing manufacturer to develop an oil/air lubrication device that is optimal for bearings. This report highlights its usage within steelmaking equipment, particularly on continuous casting equipment and steel rolling mills.

***Key Words**: oil/air lubrication, continuous casting machine, steelmaking equipment, energy saving, rolling bearing life*

1. Introduction

The rolling bearings used in steelmaking equipment are mostly subjected to severe operating conditions, such as exposure to rolling water and heat, therefore it is extremely important to maintain good lubrication in order to sufficiently satisfy bearing performance. Oil/air lubrication involves a small amount of oil being transported by high-pressure air and is anticipated to extend bearing life as it reduces the infiltration of rolling water into the bearing and forms a highly-lubricant oil film. Moreover, compared to other forms of lubrication, oil/air lubrication uses a small amount of oil which has energy-saving benefits.

As a manufacturer of rolling bearings for steelmaking equipment, JTEKT began development of oil/air lubrication technology in 1990 with the aim of improving bearing lubrication performance. Together with customers, we worked on overcoming various technical issues and improved this technology. As a result, JTEKT's technology has been adopted on a truly wide variety of steelmaking equipment to date, including continuous casting machines, steel rolling mills, wire rod/steel rod equipment and non-ferrous metal rolling mills. This paper introduces application of our oil/air lubrication technology on continuous casting machines and steel rolling mills in particular.

2. Overview of Oil/Air Lubrication

2. 1 Principle and features of oil/air lubrication

Figure 1 shows the transportation principle of oil/air lubrication. The oil inside the pipe is transported to the final lubrication point by the frictional force of compressed air. Moreover, because the oil is transported in droplets, there is minimal emission of oil mist, which does not contribute to lubrication, making it possible to keep oil consumption to the bare minimum. In addition, as compressed air, which is the force that transports the oil, is supplied to the bearing, the inside of the bearing is filled with positive pressure, making it possible to prevent infiltration of external foreign matter.

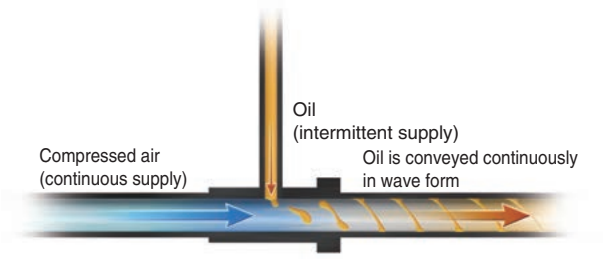


Fig. 1 Transport principle of oil/air lubrication

2. 2 Basic components of an oil/air lubrication system

Figure 2 shows the basic configuration of JTEKT's oil/air lubrication system as well as the functions and features of each component. A feature of JTEKT's products is that

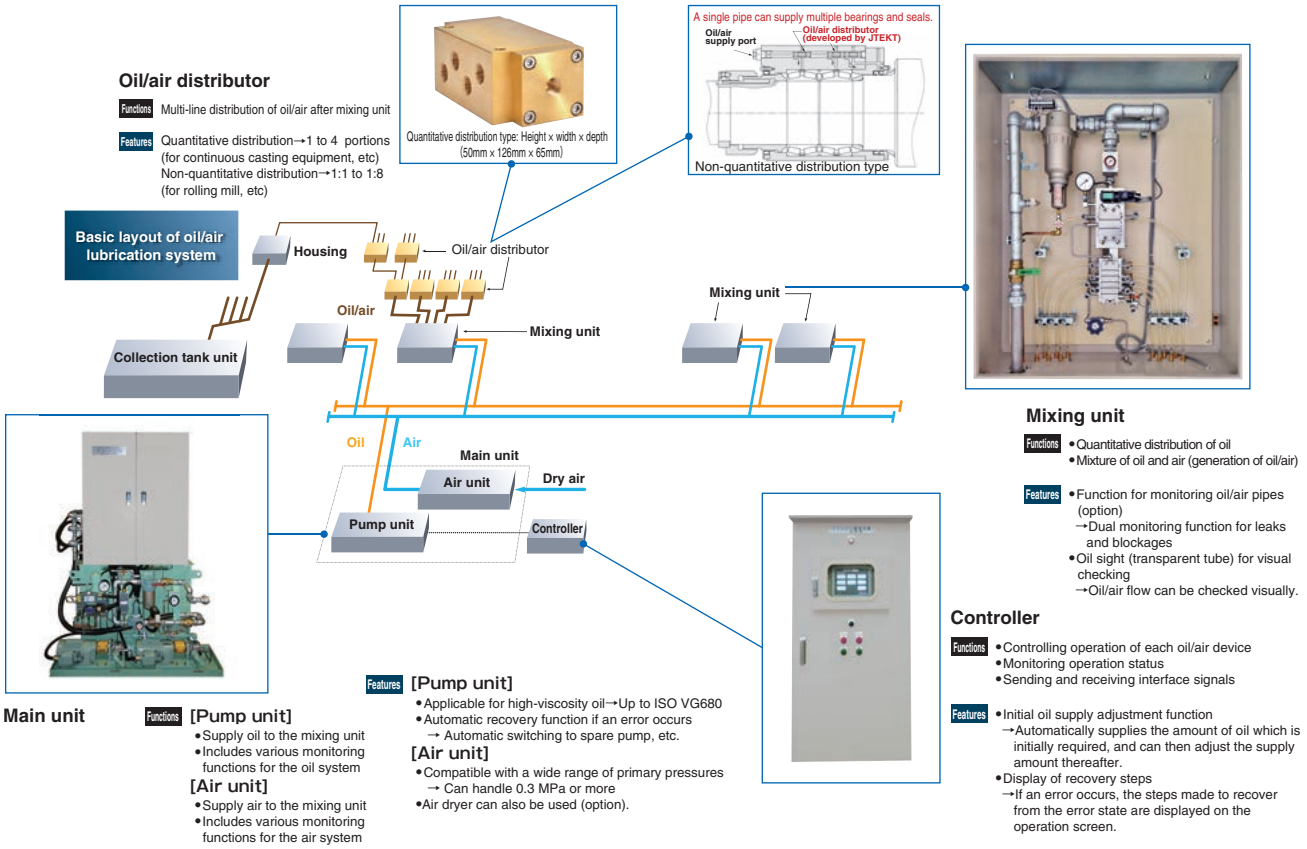


Fig. 2 Basic configuration of oil/air lubrication

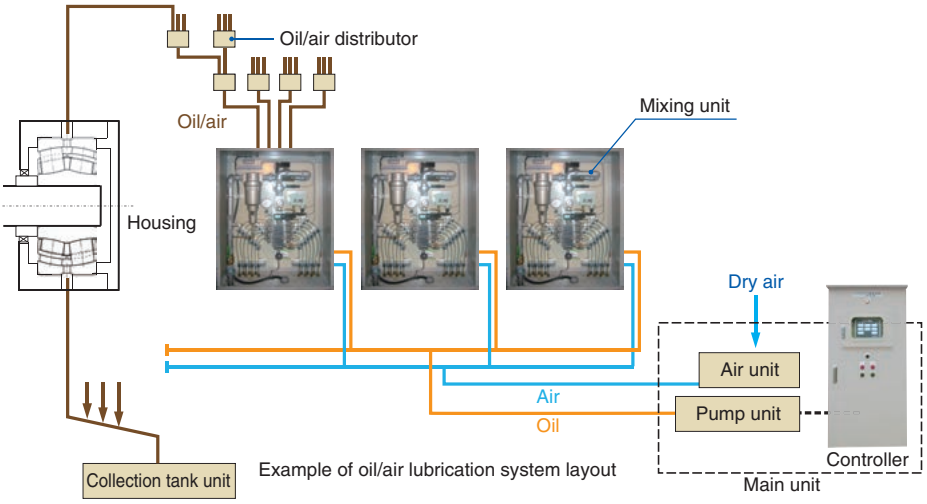


Fig. 3 Basic layout for oil/air lubrication in continuous casting equipment

each component has a high degree of freedom allowing it to be flexibly applied to suit the scale of the relevant steelmaking equipment.

3. Application to Steelmaking Equipment

3. 1 Application to continuous casting machines

Figure 3 shows the basic configuration for an oil/air lubrication system used for continuous casting machines.

Continuous casting machines use a large quantity of bearings therefore, as **Fig. 3** shows, oil/air is distributed into multiple channels using the oil/air distributor after the mixing unit. The oil/air distributor is small and has no operating parts therefore it can be directly installed into regular segments. Moreover, for continuous casting machines, two approaches are used; one where the oil supplied to the bearings is collected back into the tank (**Fig. 3**) and the other where the oil is discharged from the

oil seal installed in the housing.

In continuous casting machines, the following benefits can be anticipated when oil/air lubrication is applied.

1) Longer intervals between segment replacement due to extended bearing life.
2) Prevention of sudden accidents due to reduced bearing breakage.
3) Reduction of operating costs due to reduced lubricant consumption.
4) Reduction of maintenance cost due to reduced man-hours for disassembling and washing bearings.
5) Improved environment due to collection of oil.

Figure 4 provides one example of the results of a survey into the factors for bearing replacement when grease lubrication is used. The corrosion and the wear account for around 70% of disposal factors. If oil/air lubrication is used, the infiltration of cooling water is prevented due to the supply of compressed air and oil film strength is improved through the application of lubricant with high extreme-pressure performance, therefore corrosion and wear issues are significantly improved.

Figure 5 is an example of comparing the bearing wear amount of grease lubrication and oil/air lubrication. In the case of oil/air lubrication, bearing wear is notably reduced, therefore it can be said that applying the oil/air lubrication method to continuous casting machines greatly contributes to improving bearing life.

JTEKT believes that oil/air lubrication, which is an effective bearing lubrication method for continuous casting machines, should be developed further, and as such, we are pushing forward with total engineering including peripheral components such as bearings, oil seals and housing.

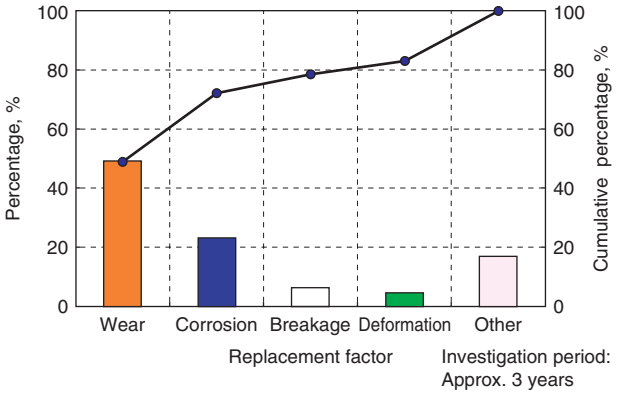


Fig. 4 Factors for replacement of spherical roller bearings

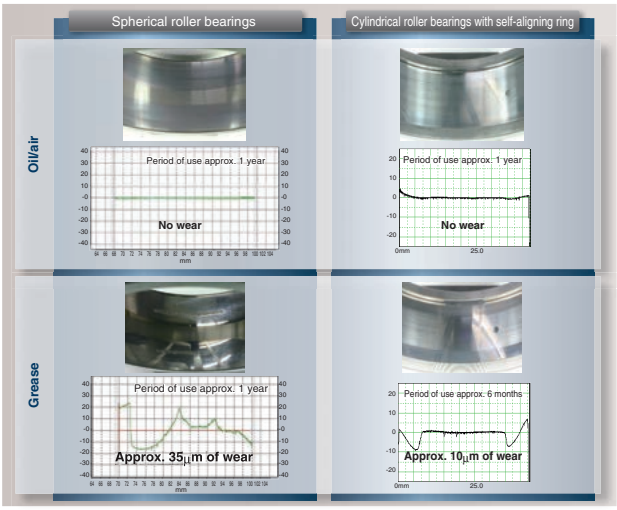


Fig. 5 Wear comparison after field test

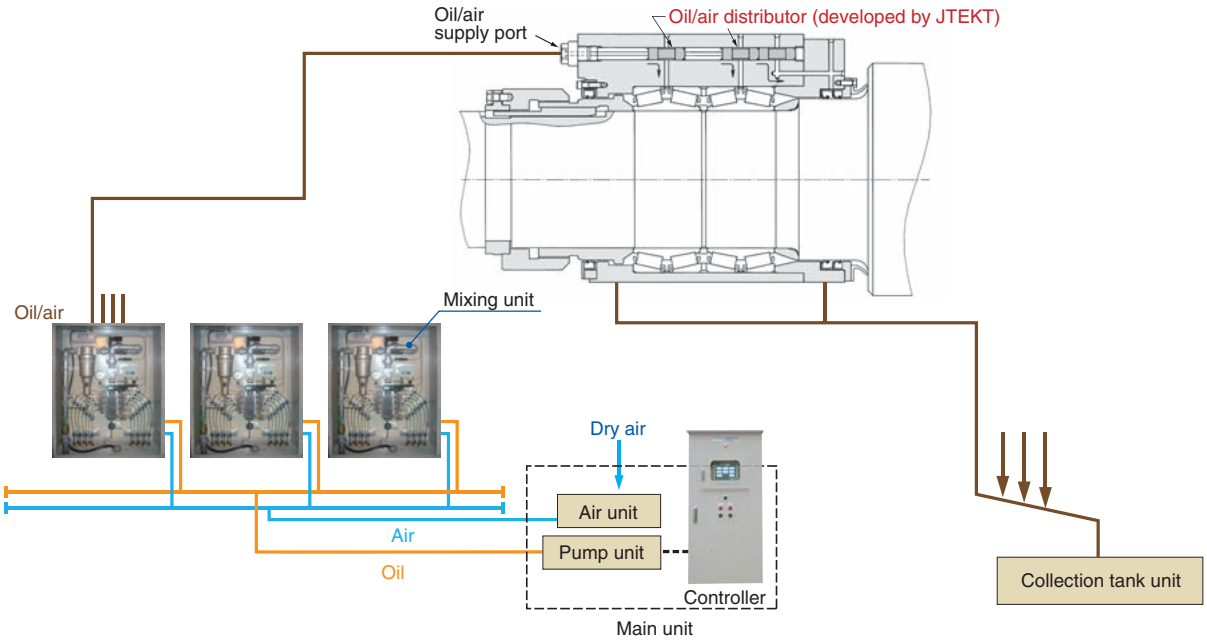
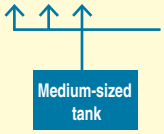
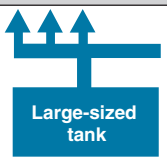
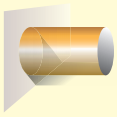
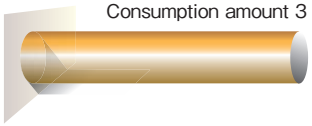
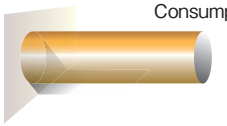


Fig. 6 Basic layout of oil/air lubrication in rolling equipment

Table 1 Comparison of lubrication methods for bearings for rolling equipment backup roll

	Oil/air lubrication	Oil mist lubrication	Forced circulation lubrication
Equipment scale Pipe size	 ・Can be used with 1 unit ・No direction limit with small-diameter pipe	 ・A unit is required for each stand ・Pipe direction is downward	 ・Unit is larger ・Pipe diameter is larger
Internal bearing pressure	Approx. 30 kPa 	Approx. 5 kPa 	Internal pressure 0 kPa 
Lubricant consumption amount			
Oils used	・High viscous oil (VG680) can be used ・Extreme-pressure oil. Synthetic oil can be used	・Limited to mist oil	・VG220 to 460

3. 2 Application to rolling mills

Figure 6 shows the basic configuration of an oil/air lubrication system on a steel rolling mill main body as one example of application.

The application of oil/air lubrication to steel rolling mills, in terms of the rolling mill main body, is suited to bearings for backup rolls which have a low roll replacement frequency. In rolling mills, the following benefits can be anticipated when oil/air lubrication is applied.

1) Longer intervals between segment replacement due to extended bearing life.
2) Prevention of sudden accidents due to reduced bearing breakage.
3) Simplification of the area around equipment through a compact lubrication unit design and smaller pipes.
4) Reduction of operating costs due to reduced lubricant consumption.

Table 1 shows the results of a comparison between oil/air lubrication and other lubrication methods.

Currently, the two mainstream lubrication methods for bearings used in rolling mill backup rolls are forced circulation lubrication and oil mist lubrication. There are few cases where oil/air lubrication is adopted. However, it is believed that the adoption of oil/air lubrication will serve the purpose of future environmental improvements and reduce of operational costs.

3. 3 Other examples of application

Places for application of oil/air lubrication other than the rolling mill main body include peripheral equipment of the rolling mill, such as the conveyance table. In the case of conveyance tables, the following benefits can be anticipated when oil/air lubrication is applied, which reduces the maintenance cost.

1) Improved bearing life due to a high sealing function.
2) Reduced motor power consumption due to low torque.
3) Reduced adhesion of leaked oil to products due to oil collection.
4) Reduced costs involved in processing oil discharged in equipment periphery due to oil collection.

4. Conclusion

The effectiveness of oil/air lubrication in steelmaking equipment has been verified through various technological developments and advancements thereof.

As a result, this lubrication method is now recognized by various customers involved with continuous casting machines and other steelmaking equipment. Moving forward, JTEKT wishes to further leverage its knowledge as a bearing manufacturer to further pursue the potential of oil/air lubrication, which contributes to stable equipment operation and energy-saving.

References

1) T. Miyachi, T.Uranishi: JTEKT ENGINEERING JOURNAL, No. 1010E (2013) 42.
2) JTEKT CORPORATION : Oil/Air Lubrication System for Industrial Equipment, CAT. NO. B1019. (in Japanese)

T. MIYACHI*

* *Industrial Machinery Application Engineering Dept., Bearing Operations Headquarters*