Effects of cylindrical pit array on tribological property of Piston Cylinder sleeve friction pair in a BW-250 slime pump

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摘要

This study designed a bio-inspired piston with a cylindrical pit array according to the BW-250 slime pump piston based on the surface structure of earthworm and leech. The friction was tested and analyzed. The friction pair mechanic system was modeled for finite element analysis, and the oil film test was supplemented. Results demonstrate that the bio-inspired piston show a lower friction force than the standard piston and a drag reduction rate that is above 10%. Cylindrical pit array can reduce the flow velocity of lubricating oil and increase the oil film pressure. The length and thickness of the oil film over the bio-inspired piston are higher than those of standard pistons.

关键词

作者关键词: Piston; Slime pump; Oil film; Bio-inspired textures
KeyWords Plus: SURFACE TEXTURE; LUBRICATION; PERFORMANCE; REDUCTION; TECHNOLOGY; BEHAVIOR; DIMPLES; SHAPE

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Influence of Bionic Pit Structure on Friction and Sealing Performance of Reciprocating Plunger

作者: Gao, TY (Gao, Tianyu)[1,2]; Su, B (Su, Bo)[3]; Jiang, L (Jiang, Lei)[3]; Cong, Q (Cong, Qian)[1,2]

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摘要

A new kind of pit-shaped bionic plunger proposes to reduce the frictional resistance of the reciprocating plunger and improve its sealing performance. According to the dorsal pore of earthworm, the bionic pit structure with different parameters designed and processed. The friction resistance test, observation test, and finite element analysis carried out. The results show that the bionic pit structure can improve the lubrication condition of the plunger surface and reduce the frictional resistance with a maximum drag reduction rate of 14.32%. The pit-shaped bionic structure can increase the storage of lubricating oil, intercept the surface streamline, and decrease the flow rate. The bionic plungers' mean contact pressure and oil film pressure increased significantly.

关键词

KeyWords Plus: LUBRICATION; REDUCTION; WEAR

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Friction and wear performance of bionic stripped piston of BW-160 slime pump

作者: Gao, TY (Gao, Tianyu)[1]; Wang, XJ (Wang, Xiaojun)[2]; Sun, YW (Sun, Yiwen)[3]; Cheng, XJ (Cheng, Xuejing)[4]; Cong, Q (Cong, Qian)[1]

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摘要

Bionic strips were designed and processed on the piston of BW-160 slime pump to improve its friction performance, decrease wear mass losses, and prolong service life. Nine stripped pistons were processed and manifested by different strip depths and included angles between stripes and piston surface. A workbench of slime pump piston was created to test the frictional force, oil film width, and wear mass losses. Test results demonstrated that the stripped structure can significantly decrease the frictional force on the piston. Optimal strip depth, included angle, and resistance reduction rates for stripped piston reached 2 mm, 90 degrees, and 53.89%, respectively. The oil film on stripped piston was significantly wider compared with that of the standard piston, thus reducing frictional force between the piston and cylinder sleeve. The wear mass losses and the wear rate of the bionic piston are lower than that of the standard piston. Finally, the friction and stress of the piston are analyzed by finite element method, and the influencing mechanism on performance of pistons was discussed. The test results provide parameters for piston design of BW-160 slime pump for engineering.

关键词

作者关键词: Friction; wear; bionics; slime pump; piston; lubrication; stress-strain

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作者: Cong, Q (Cong, Qian)[1]; Gao, TY (Gao, Tianyu)[1]; Sun, YW (Sun, Yiwen)[2]; Tian, WJ (Tian, Weijun)[1]
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摘要

The mud pump piston is a key part for providing mud circulation, but its sealing performance often fails under complex working conditions, which shorten its service life. Inspired by the ring segment structure of earthworms, the bionic striped structure on surfaces of the mud pump piston (BW-160) was designed and machined, and the sealing performances of the bionic striped piston and the standard piston were tested on a sealing performance testing bench. It was found the bionic striped structure efficiently enhanced the sealing performance of the mud pump piston, while the stripe depth and the angle between the stripes and lateral of the piston both significantly affected the sealing performance. The structure with a stripe depth of 2mm and angle of 90 degrees showed the best sealing performance, which was 90.79% higher than the standard piston. The sealing mechanism showed the striped structure increased the breadth and area of contact sealing between the piston and the cylinder liner. Meanwhile, the striped structure significantly intercepted the early leaked liquid and led to the refluxing rotation of the leaked liquid at the striped structure, reducing the leakage rate.

关键词

KeyWords Plus: SURFACE; DESIGN

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