Analysis of Brake Material Issues in the Elevator Hoisting Accident

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Abstract. Brake is the frequent-use safety of elevator parts, also it is the important basis to maintain the safe operation of the elevator. In this paper, combined with an elevator hoisting accident, the the elevator brake dismantling, internal structure type, the damage and the failure characteristics of the brake were analyzed. At the same time, the fault brake parts were analyzed in order from the aspects of material, and process of brake failure reasons were analyzed. Finally, the corresponding preventive measures were proposed according to the cause of the brake failure, avoiding similar accidents from happening again.

1. Introduction

In the present accident, a residential area just put into use, one elevator running from 16th to 1st floor. At this time there are two passengers in the elevator, when the elevator arrived at 1st floor, of which one passengers just out of the car, the car is somehow suddenly to start running, then faster and faster, and has over 27th top floor rushed to the roof , huge impact caused the car passengers remain in extremity fractures, the car ceiling and other objects fall.

Fig. 1. Accident scene

Fig. 2. Drop the car ceiling

2. Brake material analysis

After the accident, the local responsible for special equipment safety supervision and management department organized a number of technical experts rushed to the scene to investigate the cause of the accident immediately. After the scene investigation, equipment accident for a traction drive passenger elevator, manufacturing date on November 2007 (brake manufacturing date on November 2007), rated load 1000kg, rated speed 2.50m/s, layer station number 28 layer 28 station 28door (- 1F - 27F).

Through the field investigation and test technology, the accident investigation team preliminary determination of the elevator accident occurred at top and brake mechanical blockage fault occurred on. To further confirm the causes of failure of brake, aiming at the structural characteristics of the elevator brake accident, the accident investigation team to entrust the third party inspection agency to conduct in-depth analysis from the following aspects:

Fig.3. Scattered counterweight

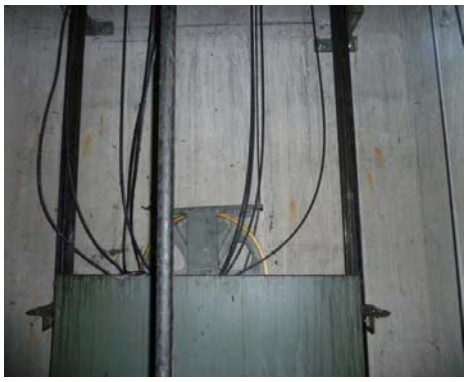

Fig.4. The steel wire rope

2.1 The failure characteristic analysis

Dismantling of elevator brake accident, analyzing its internal structure, to observe the damage, the failure characteristic of brake direct analysis.

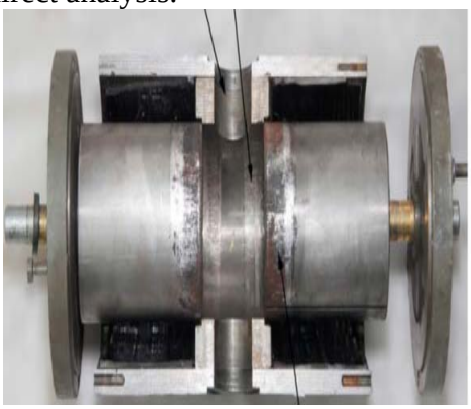

Fig.5. Elevator brake electromagnet assembly cut graph

After the Elevator brake demolition, the machine base, a guide magnetic ring (sets) along a central longitudinal incision morphologies, such as Figure 5 shows, the guide ring and the plunger (sets) with surface area have obvious longitudinal wear striations, and small granulated powders and flakes adhesion complexes in the gap region, these particles and adhesion complexes in the magnetic field were formed along the magnetic field distribution, suggesting that both ferromagnetic materials.

2.2 Material analysis

The material analysis of fault brake components, in order to analyze the failure reasons of the brake from the angle of material and technology etc..

a. By chemical analysis and magnetic properties test results show that the failure of brake piston material does not meet the relevant technical requirements of DT4 (GB/T 6983-2008).

Table1. The chemical analysis results

(wt%)

Element	C	S	Si	Mn	P	Cr	Ni	Al	Cu
Plunger	0.096	0.005	0.20	0.48	0.016	0.031	0.018	0.032	0.030
DT4 (GB/T6983-2008)	≦ 0.010	≦ 0.010	≦ 0.10	≦ 0.25	≦ 0.015	≦ 0.10	≦ 0.05	0.20~ 0.80	≦ 0.05

b. By the chemical analysis results:

The chemical compositions of fault magnetic brake does not meet the relevant technical requirements of DT4 (GB/T 6983-2008).

The fault brake release rod material to meet the relevant technical requirements of steel 45 (GB/T 699-1999).

c. By macro and electron microscope and energy spectrum micro analysis can be seen, release the brake rod appearance by galvanized, and the magnetic conducting ring of bearing hole matching surface more serious wear (unilateral wear up to 0.07 mm, and by signs of wear that loose brake rod in operation is abnormal rotation. At the same time, carrying the wear debris scattered in the magnetic coating of the inner cavity, and into the plunger and the magnetic gap.

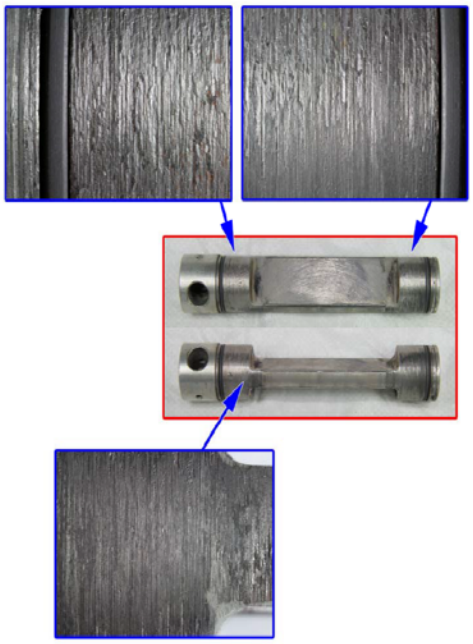

Fig.6. Brake rod and wear morphology

d. The macro and the micro analysis can see also , between the plunger and the guide magnetic ring occurred abnormal rheological adhesive wear, and according to abnormal wear distribution and wear area containing zinc particles are embedded in a predictable, abnormal wear and loose brake lever scattered debris on.

Fig.7. The plunger and sleeve (ring) between the wear phenomenon

A comprehensive analysis of the results can be inferred that brake electromagnet assembly in use occurred Nika blocking plunger die fault and the plunger and the magnetic conducting ring between abnormal adhesion wear and tear. The adhesive wear occurred mainly due to loose brake lever to the abnormal rotation and the formation of wear debris embedded piston and a guide magnetic ring gap caused by. At the same time, due to the loose brake lever hardness was significantly higher than that of the guide ring and piston, and the guide ring and piston are non normal ferromagnetic material (DT4), will increase the adsorption of iron magnetic scraps will exacerbate loosen rod wear stripping of relatively high hardness particles embedded between the conductive ring and the plunger, increased the abnormal adhesion wear the probability of occurrence .

3. The analysis of the cause of the accident

The above analysis and test technology based on the elevator brake and rushed top accidents of mechanical clamping, the braking function failure. At the time of the incident, the elevator car arrived at the flat layer region, brake control circuit is in a state of loss of power, due to the brake piston mechanical blockage fault resulting in brake can not enter the braking state, brake failure, the elevator is "out of control", the car in under the weight of gravity to move on, and gradually accelerated, eventually leading to car top punching.

4. The preventive measures

Elevator brake is the frequent use of security components, but also maintain the safe operation of the elevator. Based on the importance of the brake, the elevator manufacturing standards and the relevant national safety technical code for requirements of the brake is very clear, it is necessary to ensure adequate braking ability, but also in the manufacturing, installation, maintenance and maintenance and inspection work to have enough requirements, to ensure the safe operation of the elevator.

The accident appeared in the process of using brake ability is insufficient, reflecting the elevator maintenance unit capacity is insufficient, did not discover the potential risks and the brake problems, leading to the elevator car rushed to the top of the accident. Therefore, daily maintenance personnel should give brake and related components enough attention, regularly on the brake maintenance, ensure the elevator stops at the station when brake can output enough braking torque. At the same time, maintenance personnel should timely cleaning, adjustment, in order to avoid rust, resistance fault card brake piston for, and thus lead to injury accidents occur.

In addition, elevator safety is a systematic project, any link failure will lead to accidents, casualties and equipment damage. Lift manufacturing unit should also be strict implementation of the national elevator production regulations and rules and the safety performance of the elevator on the production is responsible for, to strengthen the quality supervision and inspection of safety components (such as brake) and security components during the fatigue life design of intrinsic safety.

References

[1]Kesheng Wang,Bing Lei. Using B-spline neural network to extract fuzzy rules for a centrifugal pump monitoring[J]. Journal of Intelligent Manufacturing . 2001 (1)

[2]Seiji Watanabe,Takashi Yumura,Yoshikatsu Hayashi,and Yukihiro Takigawa.Development of Elevator Simulator for Emergent Behavior. The 10~(th) Transportation and Logistics Conference . 2001

[3]FENG Yonghui ZHANG Jianwu School of Mechanical Engineering,Shanghai Jiaotong University,Shanghai 200240,China. HYDRAULIC ACTIVE GUIDE ROLLER SYSTEM FOR HIGH-SPEED ELEVATOR BASED ON FUZZY CONTROLLER[J]. Chinese Journal of Mechanical Engineering. 2007(05)

