

## FRICITION PROPERTIES OF CARBON-CARBON COMPOSITE AIRCRAFT BRAKES AT DIFFERENT INITIAL BRAKING SPEEDS AND PRESSURE

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### Abstract

The friction properties of B757 and A320, manufactured by Xi'an ChaoMa Technology Co.Ltd, Dunlop Co. of England and Carbon Industry Co. of France, were investigated at different initial braking speeds and pressure with HJDS-II simulating tester and MM-1000 frictional tester. It was shown that energy and torque of all brakes increase with the increase of initial braking speeds and pressure, moreover the increased tendency are almost similarly. Their friction coefficients have a low energy maximum at low speeds and pressure, then decrease with the increase of initial braking speeds and pressure. The friction coefficients of A320 brakes made by Xi'an ChaoMa Technology Co.Ltd are higher than the foreign brakes at high braking speeds and braking pressure.

**Keywords:** carbon-carbon composites aircraft brakes; friction properties; initial braking speed; braking pressure

### 1. Introduction

As we all know, friction function is the key character of the three functions of C/C composite aircraft braking materials. The friction and wear behavior have been studied by many scholars internal and foreign, the results indicate that the friction of carbon-carbon is influenced by many factors, such as preform type, microstructure of the pyrocarbon and friction surface, and also confined by heat treatment temperature and test factor. So we can say the friction property is not the natural attribute, which is the complex property of engineering system under certain

working conditions. The friction properties of two types, manufactured by Xi'an ChaoMa Technology Co.Ltd, Dunlop and Sep Carb III, were investigated at different initial braking speeds and pressures with HJDS-II simulating tester and MM-1000 frictional tester. Then, we can know the internal relations and the friction at different initial braking speeds and pressure

### 2. Experimental

#### 2.1 Source of carbon braking disc

2.1.1 B757-200 and A320 aircraft carbon braking disc manufactured by Xi'an ChaoMa Technology Co.Ltd;

2.1.2 B757-200 aircraft carbon braking disc made by

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Dunlop Co. of England;

2.1.3 Sep Carb III of A320 aircraft carbon braking disc manufactured by Carbon Industry Co. of France.

**2.2 Friction testing**

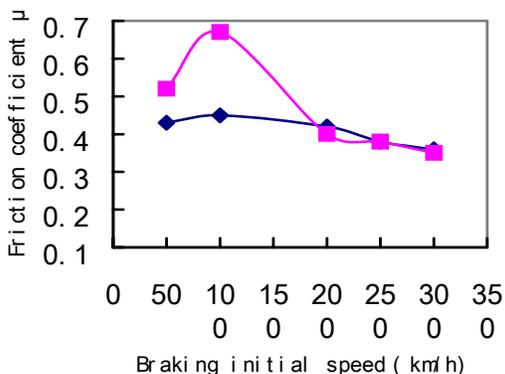
The friction properties of B757-200 aircraft braking disc were investigated at different initial braking speeds and pressure with HJDS- II simulating tester and MM-1000 frictional tester.

**3. Results and discussion**

**3.1 Friction properties at different initial braking speeds**

With HJDS- II simulating tester, we investigated the friction properties of B757-200, made by us and Dunlop, and then compare the difference. as shown in Fig.1.

Fig.1 illustrate that the friction coefficients of our disc and Dunlop disc exist the sub-peak at the speed of 50km/h with the speed increasing to 100km/h, two



**Fig 1.** Relation between friction coefficient and braking initial speed: (◆) B757 carbon braking disc made by us, (■)Dunlop carbon braking disc.

all reach the peak, means the low energy-peak characteristic. After that, the coefficient decreases

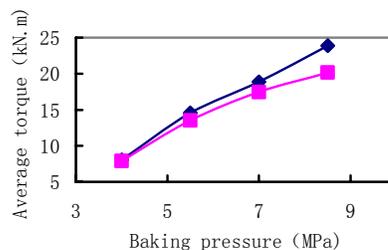
gradually with the increasing initial speed, but still keep the high level.

The carbon-carbon composites have different graphitization degree. Coefficient of Dunlop disc is higher than our's at low braking initial speed(50~100km/h). The value of Dunlop is higher than us about 20% with low hardness, so rough debris could be created under shear stress. More debris is built up on the surface, which can not be crushed wholly and then slough by the energy at 100km/h, so the coefficient reach 0.67. The effect of coefficient on graphitization degree diminishes when the initial speed becomes more than 200km/h, whose energy is enough to crush debris of carbon-carbon discs with different graphitization degrees to smooth layer leading a consistent coefficient.

**3.2 Friction properties at different braking pressure**

With HJDS- II simulating tester, we investigated the friction properties of B757-200, made by us and Dunlop at different pressure, then compare the differences. as shown in Fig.2 and Fig.3.

Fig.2 and Fig.3 show as follows:

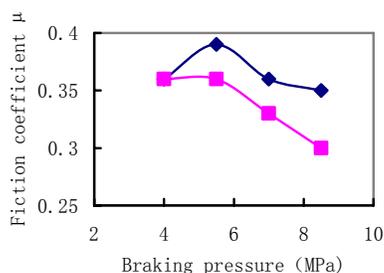


**Fig 2.**Relation between average torque and braking pressure on HJDS- II simulating tester: (◆) B757 carbon braking disc made by us, (■)Dunlop carbon braking disc.

(1). Braking torque in dynamometer simulating tester can be shown as following equation:

$$M=k \cdot \mu \cdot p \quad (1)$$

In the equation: M-average braking torque; k-structure constant, concerned with braking disc and plunger;  $\mu$ -coefficient of dynamic friction; p-effective braking pressure.



**Fig 3.** Relation between friction coefficient and braking pressure on HJDS- II simulating tester: (◆) B757 carbon braking disc made by us, (■)Dunlop carbon braking disc.

From the equation(1), average braking torque is direct proportional with the braking pressure, so the average braking torques of B757 carbon braking disc made by us and Dunlop carbon braking disc increase with the increasing braking pressure. Their tendency is fundamentally similar, but our B757 carbon disc have a higher average torque at the same braking factors.

(2).The friction coefficients of our's and Dunlop carbon baking disc appear reducing tendency with the increasing pressure, the amplitude of the former is lower than the latter. The average torque increases with the increasing braking pressure, so the temperature of friction surface rises, which leads decreasing shear strength and decreasing friction coefficient.

#### 4. Conclusions

The energy loading and average braking torque of

B757 carbon braking disc made by us, Dunlop, Sep Carb III carbon braking disc increase with the increasing braking pressure at different initial braking speeds and pressure. Their tendency is fundamentally similar; Low energy-peak of friction coefficient appears at low velocity and low pressure, and then reduces with the increasing braking initial velocity, but the carbon braking disc manufactured by Xi'an ChaoMa Technology Co. Ltd exist higher friction coefficient than foreign carbon disc. The originality innovation achievement is a grave breaking in high friction energy of the large-sized civil carbon-carbon in our country, and realizes the fly-past development in domestic of large-sized civil aircraft carbon-carbon braking disc

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