HYDRODYNAMIC ANALYSIS OF ROWING HULL BASED ON THE FLOAT POSE

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The rowing is one of the important events in the Olympic Games. In order to study the hydrodynamic performance of rowing, we finished the linetype mapping and the calculated the parameters of the double rowing model. Based on the resistance data of rowing at different states, we obtained the rule of resistance of rowing at different speeds. The study indicated that the enhancement of the physical force of the athletes seemed to be in proportion to the weight of the athletes and the results based on research shallow affected and optimized the design.

KEY WORDS：speed, experiment, resistance

INTRODUCTION:

It is found that the new style rowing has appeared in the recent several Olympic Games. On the one hand, they trained the athletes and enhance the athlete’s ability by use of the high-tech methods; on the other hand, they applied the fluid mechanics to study the hydrodynamics of the rowing. Hydrodynamic performance of the rowing included the hydrodynamic performance of the hull and oars and started in the nineties of the twentieth century (Scrag, Bruce & Nelson, 1993). Zheng Weitao (2000) summarized the development of the oar and the dependence of some energetic on the concerned physical parameters, such as the aspect radio, the depth of oars in water, the frequency, etc. Ge Xinfa (2004) summarized the development of the hydrodynamic performance of the rowing hull. Zheng Weitao (2005) reported the up-to-date development of the wave-making of the rowing. At present, there are a lot of questions about the hydrodynamic performance of the rowing that should be studied in China in the future. The experiment is a key method that studies the resistance of the rowing. This study analyzed the hydrodynamic performance of the rowing by using the experimental method. The results showed that it was necessary to consider the influence of the speed of the rowing on the effect of the training. Moreover, it could be taken as the reference for the further experiment, i.e. confirming the optimum of the shape of the rowing hull and the simulation.

METHOD:

In order to investigate the hydrodynamic performance of the rowing, the linetype was mapped and the parameters of the double rowing model were calculated. Based on the characteristics of the rowing competition, the resistance experiment was conducted when the float pose of the double rowing was different. The tonnage was 167, 187, 207 kg and the weights of the corresponding athletes (double) was 134, 154, 174 kg respectively. The experiment was carried out respectively in the international towing tank laboratory (the tank is the member of the ITTC). The main dimension, the experimental state, and the experimental velocity were shown in table 1, 2 and 3 respectively.

RESULTS:

The results were graphically summarized in Figure 1-4. The curves of the resistance related to the speed were shown when the float poses and/ or tonnages were different.

Table 1 the main dimension of the rowing

the main dimension	symbol	unit	the double rowing		
tonnage	□	kg	167	187	207
lenght of the waterline	Lwl	m	9.553	9.654	9.724
board	B	m	0.366	0.372	0.377
draft	T	m	0.102	0.111	0.118
wet area	S	m^2	3.137	3.309	3.447

Table 2 the experimental state

item	tonnage（kg）	State
1	187	normal float
2	187	Ahead 70kg and tail 90 kg
3	187	Ahead 90kg and tail 70 kg
4	167	Normal
5	207	Normal

Table 3 the experimental velocity

item	1	2	3	4	5	6	7	8	9	10	11
velocity (m/s）	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Fn	0.103	0.155	0.207	0.258	0.310	0.362	0.413	0.465	0.516	0.568	0.620

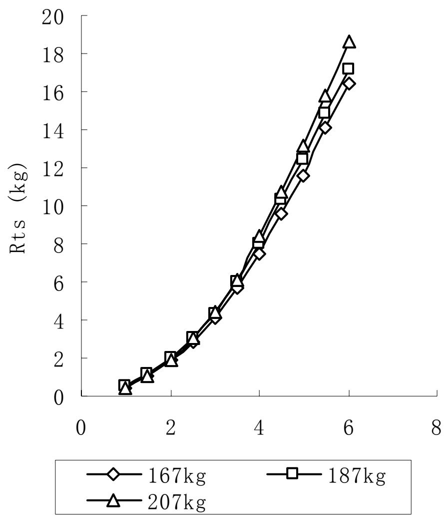

Figure 1: Curves of total resistance related to the speed at the different tonnages when the rowing normally floated

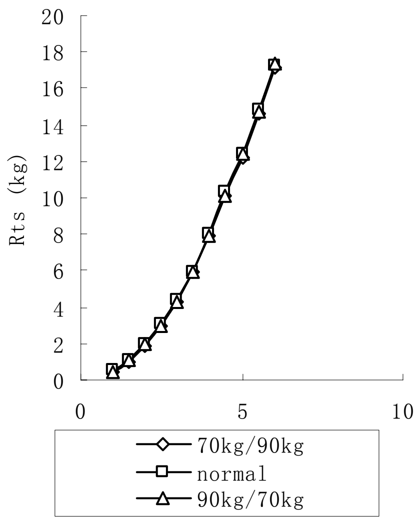

Figure 2: Curves of the total resistance related to the speed when the float poses were different

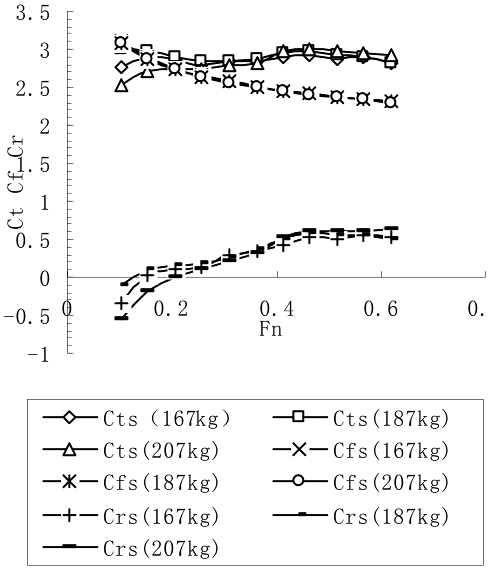

Figure 3: Curves of the different resistances related to the speed at the different tonnages

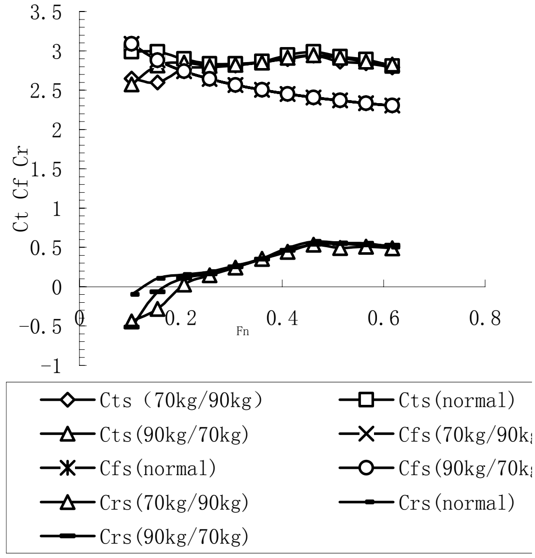

Figure 4: Curves of the different resistances related to the speed when the float poses were different

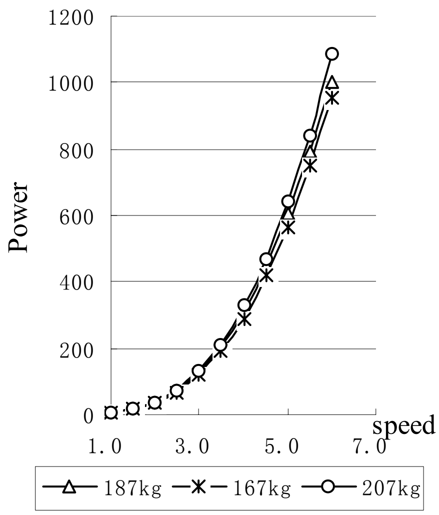

Figure 5: Curves of the parcatice power of the rowing

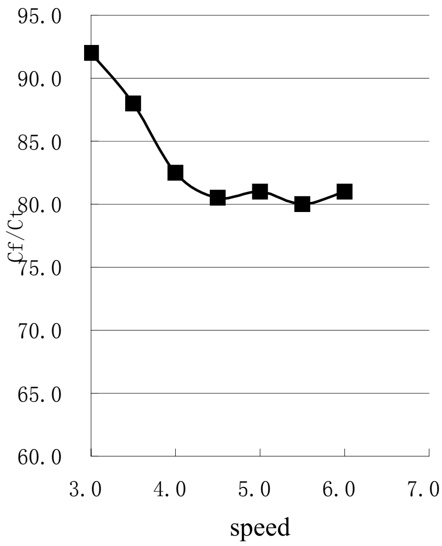

Figure 6: Curves of the total resistance related to the frictional resistance

DISCUSSION:

The resistance of the rowing: It was shown in Figure 1-2 that the resistance of the double rowing increased when the velocity and the tonnage increased

The influence of the position of the athlete's sea on the resistance: In Figure 1-4, by consulting the references, it was found that the sinkage was small, whereas the pitch was big when the velocity of the rowing increased. When the speed of the rowing was 4.5-6.0m/s, the resistance of the normal float rowing was bigger than that of the rowing whose stern and stem submerged. When the stern submerged, the resistance was the smallest. Therefore, it was favourable that the heavy athlete should seat ahead while the light athlete should seat back.

The practical power: In Figure 5, the results showed that the much power was needed if the athlete weight was high at the same velocity. So the athletes should control their weight, especially decreasing body fat content. In Figure 6, the proportion of the frictional resistance to the total resistance was more than 80% and the smallest one appeared when the velocity was 4.5-6m/s.

The resistance per one tonnage and the influence of the weight change on the resistance: In Figure7, the results showed that the resistance per tonnage was smaller as soon as the tonnage was bigger. At present, some researchers think that the athletes with higher weight may have increased volume of the muscle, so the power and physical ability would be enhanced. However, this experiment indicated that the water sports were different from the onshore sports in that the higher weight couldn't always enhance the physical ability, the tonnage would begin bigger what the resistance would be bigger and the athlete's physical ability related to the weight should have an appropriate proportion.

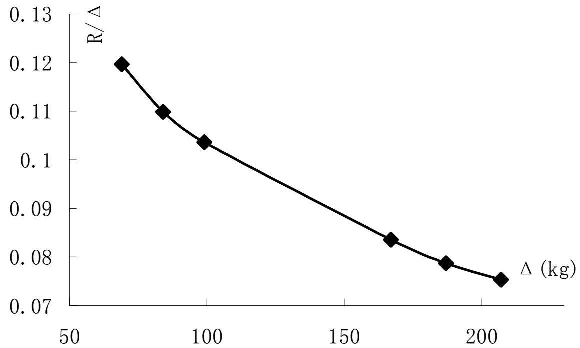

Figure 7: Resistance per tonnage

CONCLUSION:

The total resistance and practical power became when the velocity and the athlete's weight increased higher. However, for the different athletes, the increments of the resistance varied when the weight increased. So it was necessary to control weight properly. The results will be the reference for the next experiment, investigating the optimum of the shape of the rowing hull and the simulation.

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