长距离输水系统停泵水锤的数值模拟 Numerical Simulation of the Water Hammer Caused by Accidental Pump-stop in Long Water Supply Systems

王文全 张立翔 闫妍 曾云

昆明理工大学

关键词： 泵站 供水工程 水力计算 水锤压力 水锤防护

摘　要： 运用瞬态水力学理论和特征线方法，结合某实际工程，对联合采用空气阀、泄压阀和二阶段缓闭蝶阀进行水锤防护的长距离有压输水管道系统的事故停泵水力过渡过程进行了计算和分析，得到管线沿程的水锤压力包络线和空化体积曲线，以及典型断面的压力时程线。计算结果表明，采用两阶段缓闭蝶阀、泄压阀和空气阀进行水锤安全防护是十分必要的，有利于抑制正水锤压力的继续升高和阻止负水锤压力的持续降低，防止断流弥合水锤的发生。但从计算结果看，管内仍存在局部空化现象，需要进一步优化空气阀的布置。 In accordance with the characteristics of a long water pipe supply system with water hammer, the analysis of the protecting devices combined with the air valve, pressure relief valve and slowly closed plate valve was carried out for the transient process caused by accidental pump-stop based on the theory of water hammer and the method of characteristics. The pressure of water hammer and relative cavitating volume along the pipeline were obtained simultaneously. The evolvement of pressure of water hammer against time was achieved. The numerical results showed that the present water hammer protections to the pipeline system were necessary, which restrained not only the continuously rising up but also the excessively decreasing of water hammer pressure and were helpful to suppress the occurrence of water column separation. However, the results also showed the cavitations in local raised position of pipeline. The optimization of the position about air valves should be implemented further.

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