

First International Seminar on Road
Tunnel Operation Management and Safety

Research on Illumination Energy Saving Technique of Highway Tunnel

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Energy Saving in China

Energy saving is a mainly problem to be faced by the developing countries. "The middle and Long Period Special Planning of Energy Saving" was published by Chinese government in 2004. It states the efficiency of energy saving is 2.2% for each year from 2003 to 2010, every ten thousand Yuan GDP energy saving in 2010 requires to decline 18% than 2003, and the mainly unit energy saving is near or up to international level of the early period of 90th 20 century. National "the 11th of five years" planning states, the aims in the nearly five years are to increase the efficiency of resource utilization and decline the unit GDP energy consumption about 20% than the end of "the 10th of five years"

东部半小时-覆盖率86%
中部1小时-覆盖率80%
西部2小时-覆盖率50%

国家高速公路网规划

The development of Chinese Tunnel

Coastal, there are Bohai sea crossing project, Da Lian sea crossing project, Qing-Huang under sea tunnel object, Chong Ming Island chunnel project, Hangzhou bay project, Taiwan Channel Connection project, Xiamen East Chunnel project, Hongkong-Zhu-Marco sea crossing project, Qiongzhou Channel project.

Along the River, River Crossing project is constructing in Ningbo, Guangzhou, Shanghai, Nanjing, Wuhan, Chongqing, etc..

Energy consumption at Road Tunnel

Energy consumption in road tunnel is so tremendous. Calculating by theory, the value of electricity is about three powers of the value of ventilation. Normally, energy consumption at ventilation is about 70% to 80% of daily tunnel energy consumption. Apart from a little bit less electricity is used at night and in a cloudy day, full-load running is performed almost in all of other time. This not only produces great deal of wasting in electric energy consumption, but also brings more spoilage to equipment. Energy consumption at Qinling Zhongnanshan Highway Tunnel (18.02km) is up to 7,880,000kwh every year. The West-lake North Section Tunnel which is in the process of building of Shanghai-Chengdu Highway is 150km(one direction). Illumination electricity has been a heavy burden in highway operation management, and even unable to make ends meet.

Current Status of Energy Saving for Highway Tunnel of China

The mostly methods

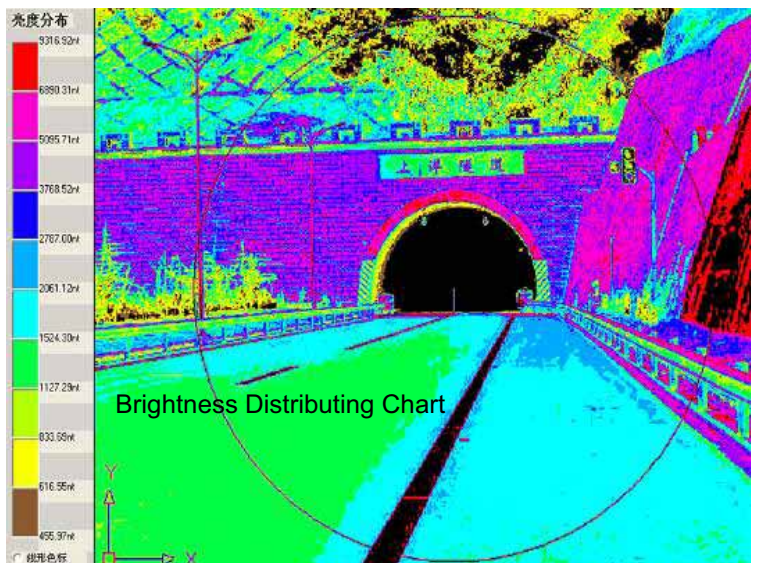
Considering the power supply and illumine source in design.

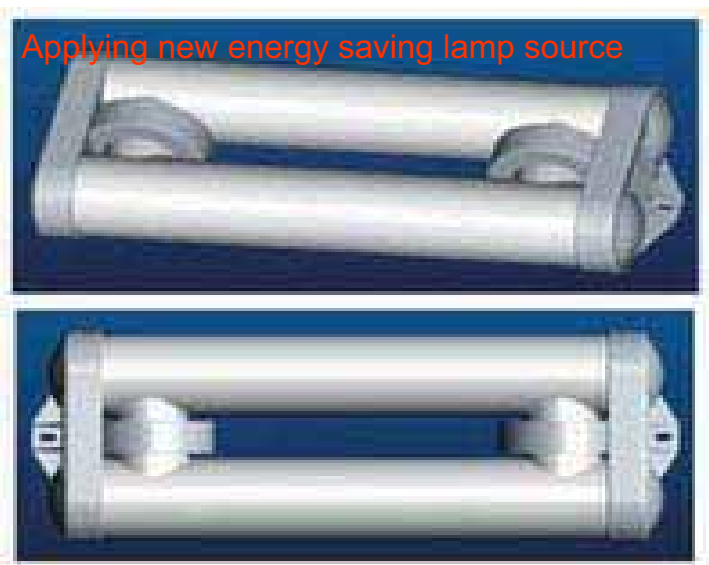
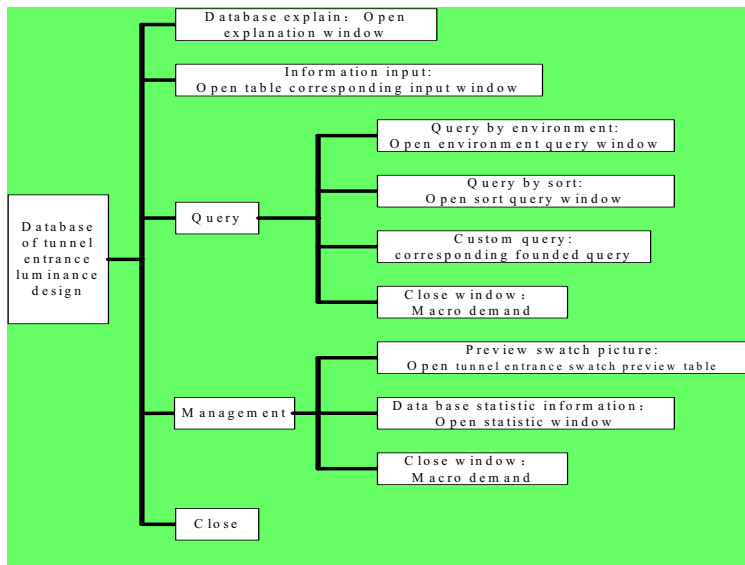
Achieving energy saving by stage implementing and parameters optimizing

The mostly technologies

Frequency conversion timing, Fluorescence lamp, High efficiency energy saving illumination lamp, SLM street lamp electricity efficiency management system and no-harmonic high voltage frequency converter.

Research on entrance illumination parameters of Road Tunnel





The values (cd/m²) of lightness at each stage of the north hole of YanLie mountain tunnel (applying electromagnetism induction lamp)

Illumination stage	Entrance Stage	Transition Stage 1	Transition Stage 2	Middle Stage	Exit Stage1	Exit Stage2
Requiring Value	140	42	14	4.5	22.5	22.5
Testing Value	60.5	39.9	25.6	5.0	24.2	37.7

The symmetrical value of ground at the north hole of YanLie mountain

Item	The total symmetrical value of ground	The lengthways symmetrical value of ground
Requiring Value	0.4	0.6-0.7
Testing Value	0.87	0.95

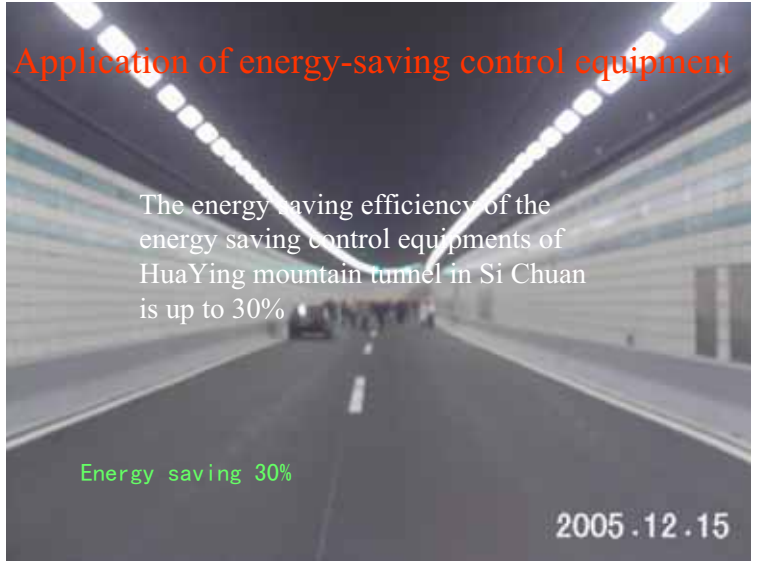
P.S. the upper data multiplied the maintain coefficient of electromagnetism telepathy lamp

Investigation result of drivers' illuminating effect

Research Items	Evaluation Effect	Person	Proportion
Strength Contrast of Beam (feeling)	Electromagnetic induction lamp strong	172	89.12%
	Sodium lamp strong	16	8.29%
	Same	5	2.59%
Safety Contrast	Electromagnetic induction lamp strong	171	88.60%
	Sodium lamp strong	15	7.77%
	Same	7	3.63%
Effect	Electromagnetic induction lamp strong	165	85.49%
	Sodium lamp strong	22	11.40%
	Same	6	3.11%



LED lamps are applied to Guizhou highway



Application of energy-saving control equipment

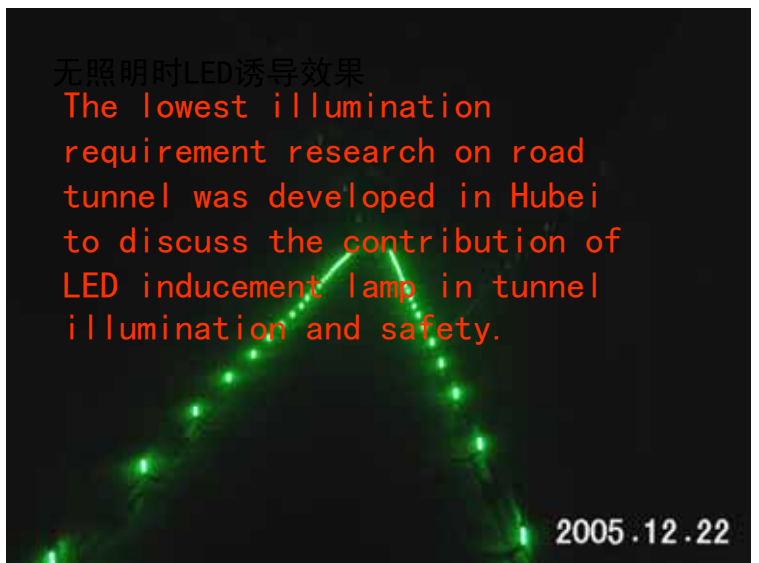
The energy saving efficiency of the energy saving control equipments of HuaYing mountain tunnel in Si Chuan is up to 30%

Energy saving 30%

2005.12.15



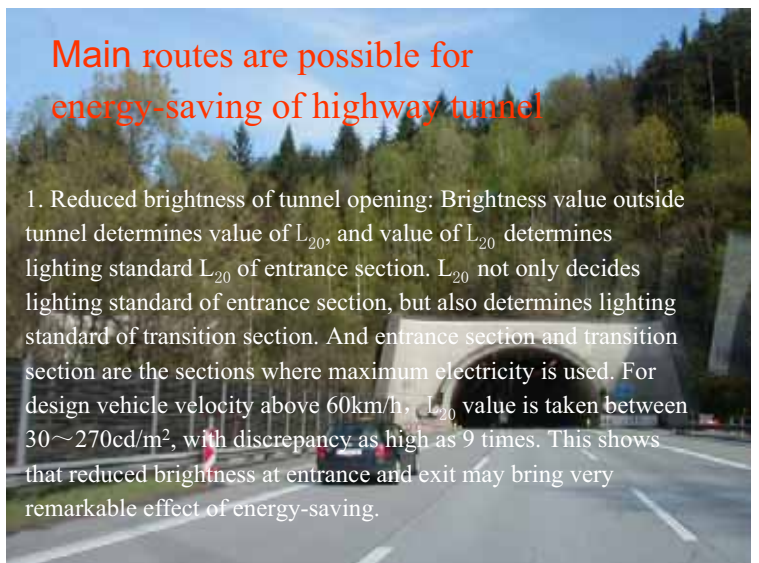
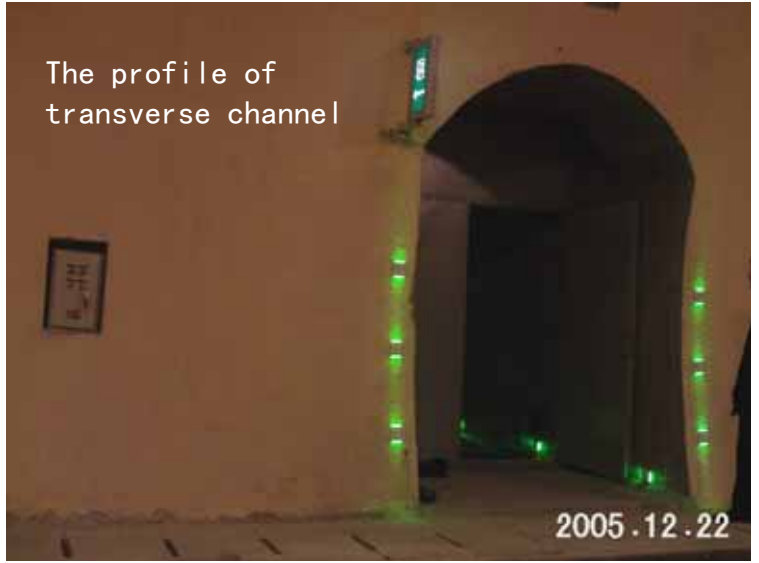
Dezhou was been named the sun city of China in June 2005; applying for taking the international sun city conference in 2010;the solar energy application of tunnel illumination energy saving research on less than 500m tunnels was organized by Chinese ministry of communications.



无照明时LED诱导效果

The lowest illumination requirement research on road tunnel was developed in Hubei to discuss the contribution of LED inducement lamp in tunnel illumination and safety.

2005.12.22



2.Improved reflectivity of road surface: Cement concrete road surface causes big noise, and bitumen road surface allows small noise and comfortable driving, but pollution is easily caused by a fire. Considering from view of lighting and based on “specifications”, conversion between average brightness and average luminosity, bitumen road surface is (15~22) lx/cd·m⁻², and cement concrete road surface (10~13) lx/cd·m⁻². Calculated by average value, use of cement concrete road surface will save energy 61% more than that in adoption of bitumen road surface.

3.Application of energy-saving control equipment: This mainly includes light regulation control equipment and voltage regulation control equipment, both being used in Xiamen Haicang Tunnel and Sichuan Mt.Huaying Tunnel with good results. According to test report by Sichuan Provincial Energy-Saving Center, energy-saving of 29.8% is achievable when voltage regulation control unit is used.

4.Optimized parameters of lighting design:Using design velocity of 100km/h will consume 100% more electric energy than design velocity of using 80km/h. For big traffic volume, using design velocity of 80km/h will consume 80% more electric energy than using design velocity of 60km/h. For small traffic volume, 67% more electricity will be consumed.

5.Improved reflectivity of wall: Wall and road themselves in tunnel provide a background to an obstacle in tunnel. Better reflectivity of wall will enable reflectivity from light on wall to achieve stronger illumination of road. Reflection of wall should be 0.6-0.7 or better, and its surface should not be too glasslike to prevent glitter of come-and-go vehicles.

6.The low energy consumption lamp choosing



Fluorescence Lamp



Sodium Lamp



Electromagnetic Induction Lamp



LED Lamp

7..Adoption of rational way of installation: For way of installing lamps in basic section of tunnel include single row middle installation, symmetric installation on both sides and staggered installation on both sides. In different ways of installing lamps, quantity of lamps and degree of easiness in maintenance are not identical. At present, the newest way of installing lamps is single-row middle slanting installatio, which is not only energy-saving, but also easy to maintain.

8..Selection of highly efficient way of lighting:Compared with frontlighting lighting, backlighting lighting may enhance light efficacy by 30%

9.Intelligent control model:Automatic lighting control according to variety of traffic volume and vehicle velocity.

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