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A Study of Replacing Mercury Lamps with High Pressure Sodium Lamps in the Street Lighting Networks of the State of Kuwait

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Abstract
This paper intends to briefly compare between using Mercury lamps and High Pressure Sodium lamps in the street lighting networks in the State of Kuwait. This will lead us to show the advantages and disadvantages of each of them (Mercury and High Pressure Sodium) in the street lighting networks. In addition, we are going to introduce some facts and figures from Ministry of Electricity and Water in the State of Kuwait (MEW) to support our study as a case study.
Keywords: Mercury lamps, High Pressure Sodium lamps, Street lighting networks

I. Introduction

Replacing Mercury lamps with High Pressure Sodium lamps is considered to be one of the major and important projects within Ministry of Electricity and Water (MEW) in the State of Kuwait. This is due to different reasons which will be introduced and discussed in this study. The project is still in progress and the target is to replace 100% of Mercury lamps with High Pressure Sodium lamps (approximately 70% of the project is achieved, according to the statistic study issued by MEW 2014).

II. Mercury lamps in the street lighting networks

Mercury Lamps were used since late 40s worldwide. It is considered as one of the glowing light bulb. In sixties, Mercury lamps developed hugely to overcome some problems such as the colour of the lamps. This leaded to improve and to correct the colour of the Lamps. Few years ago the Mercury lamps production stopped by the United State of America because of the danger of the use of this type of lamps on the human lives since it contains mercury which is too dangerous for the environment (according to MEW sources). Therefore, the manufacturing of Mercury lamps for street lighting was banned in the United State of America. As a result, MEW decided to change their street lighting networks from Mercury lamps to High Pressure Sodium lamps in order to preserve the environment.

175W Mercury lamp, the small diagonal cylinder at the bottom of the arc tube is a resistor which supplies current to the starter electrode.

III. Sodium Lamps in the street lighting networks

High Pressure Sodium Lamps for street lighting networks were used in 70s. Two types of Sodium lamps were produced; High pressure Sodium lamps and Low Pressure Sodium lamps. High Pressure Sodium lamps are used hugely in the street lighting networks because of the efficiency. The colour of

these lights is yellow which is not preferable, and the corrected colour one is very expensive although it is available.

100 W High Pressure Sodium lamp

IV. Comparison between Mercury and High Pressure Sodium Lamps

This comparison will be discussed in details to introduce and discuss the advantages and disadvantages of Mercury lamps and High Pressure Sodium lamps. The table below is showing the comparison as following;

Lamp type	Mercury Lamps	High Pressure Sodium Lamps
Operating life time	16000-24000 hr.	<24000 hr.
Lumens per Watt	30-65	60-120
Color temperature	Intermediate - fair	Warm - fair
C. rendering index	3	1-2
Consists of	Arc tube with mercury and argon gas and quartz envelope, third electrode, outer phosphor coated bulb, outer glass envelope	Ballast, high- voltage electronic starter, ceramic arc tube, xenon gas filling, sodium, mercury

In more details, the comparison between Mercury lamps and High Pressure Sodium lamps can be discussed as following:

1. Operating life time: The operating life time of High Pressure Sodium Lamps is better than the one of Mercury lamps, and this can be considered as an advantage for High Pressure Sodium Lamps type to be used in the street lighting networks.
2. Lumens per Watt: From the above table, it is clear that the lumens produced by the High Pressure Sodium lamps are significantly higher than the lumens produced by Mercury Lamps per consumed Watt. Therefore, High Pressure Sodium lamps can be considered as an energy saving compare with Mercury lamps. When we apply this factor to what is used in the MEW street lighting networks we have found the following:

High Pressure Sodium Lamps types used in MEW street lighting networks are the following:
70 Watt – 5800 Lumens
150 Watt – 13500 Lumens
250 Watt – 25000 Lumens
400 Watt – 47000 Lumens

Where, previously when MEW used to have Mercury Lamps in the street lighting networks the following were used:
125 Watt – 6250 Lumens
250 Watts – 13500 Lumens
400 Watt – 23000 Lumens
1000 Watt – 58500 Lumens

From the above figures, it is concluded that MEW has saved the electrical energy (approximately more 30 %) by replacing Mercury lamps with High Pressure Sodium Lamps in their street lighting networks.

V. Replacing Mercury Lamps with High Pressure Sodium Lamps in MEW; Facts and Figures

In order to replace Mercury lamps with High Pressure Sodium lamps, MEW has developed its street lighting networks completely. For that reason, the lamp posts were changed from 4 meters to 6 meters high to suit the new installations. The following table shows the numbers of changed lamp posts, as well as establishing new districts (needed new lamp posts):

	Asema Governorate	Hawalli Governorate	Mubarak Alkabeer Governorate	Ahmadi Governorate	Farwania Governorate	Jahra Governorate	**Total**
4 m Lamp posts	3242	1710	106	8311	1694	5803	**20866**
6 m Lamp posts	5236	2624	11089	2492	3474	2967	**27882**

The street lighting networks were developed by replacing Mercury lamps with High Pressure Sodium lamps, according to the new specifications of the Ministry of Electricity and Water in the State of Kuwait. Which contributed to improvement of the lighting and provide loads up to 30% and the

preservation of the environment and that the gravity of the Mercury to the environment.

The street lighting networks has been developed up to 70% and the process still on going. Most of major streets and highways are developed, such as: Sixth Ring - Fifth Ring - King Fahd Road - Fahaheel - Jahra Road (80) - by abundance (306) - by 212 - 213 road - the road to independence - Khalid bin Waleed Street - Mubarak Al-Kabeer Street - Wall Street - Ahmad Al-Jaber Street - Jaber Al-Mubarak Street - Shuhada Street - by al-Ghazali (60) - by the parties - most areas of the provinces of the main streets of Kuwait.

VI. Conclusion

Replacing Mercury lamps by High Pressure Sodium lamps in the street lighting networks of the State of Kuwait has significant benefits, especially related to saving the environment (preservation of the environment from pollution), as well as saving electrical energy. Also, maintaining the quality and efficiency of the street lighting networks by installing the up to date equipment (to match the modern world).

References

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