电网技术 2011, 35(3) 140-145 DOI: ISSN: 1000-3673 CN: 11-2410/TM

高电压技术

自然污秽成分CaSO4对电力设备外绝缘沿面绝缘特性的影响综述

李恒真，刘刚，李立涅

华南理工大学 电力学院，广东省 广州市 510640

摘要：

为对电力外绝缘表面污秽主要成分进行深入研究，调研了国内外关于CaSO4成分的相关研究。从CaSO4的来源、富集、其对污秽测量和污闪电压的影响，以及其在污秽中含量的变化对防污形势的影响几个方面进行探讨。最终认为CaSO4主要来源于煤烟型大气污染，在绝缘子表面有一定的富集作用。CaSO4为微溶物且闪络电压较高，会导致传统方法测量自然污秽的等值盐密虚高，导致人工污秽闪络电压偏低；而自然污秽和人工污秽的CaSO4含量差异进一步降低了人工污秽闪络电压。将来，CaSO4作为电力外绝缘污秽中主要成分的地位可能被硝酸盐所取代，并导致更为严峻的防污形势。

关键词：

A Review on Influence of Natural Contaminant CaSO4 on Surface Insulation Characteristics of External Insulation of Power Equipment

LI Hengzhen ,LIU Gang ,LI Licheng

School of Electric Power, South China University of Technology, Guangzhou 510640, Guangdong Province, China

Abstract:

To research main components of contaminants on the surface of external insulation of power equipment in depth, the authors investigate and survey research results related to CaSO4 home and abroad. The source and enrichment of CaSO4, its influences on the measurement of contaminants and pollution flashover voltage as well as the influences of the changes of CaSO4 in contaminant contents on anti- contamination situation are discussed and analyzed, and the conclusions are as following: CaSO4 originates from coal-smoke air pollution and is enriched on insulator surface a certain extent. The property of CaSO4 that it is a kind of slightly soluble substance with higher flashover voltage leads to contrafactual high value of equivalent salt deposit density measured by traditional methods, and it makes artificial contamination flashover voltage unrealistically low; however artificial contamination flashover voltage is further decreased due to the difference of CaSO4 content in natural contaminants and artificial contaminants. In the future, the status of CaSO4 in the principal contaminant components of power equipment external insulation would be displaced by nitrate and it leads to a more serious antipollution condition.

Keywords:

收稿日期 2010-07-28 **修回日期** 2010-11-16 **网络版发布日期** 2011-03-11

DOI:

基金项目:

国家重点基础研究发展计划项目(973项目)(2009CB7-24507)。

通讯作者: 李恒真

作者简介:

作者Email: zidian_2008@foxmail.com

参考文献：

[1] 宿志一，李庆峰．我国电网防污闪措施的回顾和总结[J]．电网技术，2010，34(12)：124-130． Su Zhiyi，Li Qingfeng．Historical review and summary on measures against pollution flashover occurred in power grids in China[J]．Power System Technology，2010，34(12)：124-130(in Chinese)． [2] 苑吉

河，蒋兴良，张志劲，等．高海拔现场标准悬式绝缘子的交流污闪特性[J]．电网技术，2009，33(5)：54-57．Yuan Jihe，Jiang Xingliang，Zhang Zhijin，et al．AC pollution flashover performance of standard suspension insulators at high altitude sites[J]．Power System Technology，2009，33(5)：54-57(in Chinese)．[3] 范建斌，黄志秋，谢荣坤，等．直流输电线路Y型绝缘子串污闪特性研究[J]．电网技术，2007，31(18)：28-31．Fan Jianbin，Huang Zhiqiu，Xie Rongkun，et al．Research on pollution flashover performance of Y-type of insulator strings used in HVDC transmission line[J]．Power System Technology，2007，31(18)：28-31(in Chinese)．[4] 殷琼，陈原．高导电性降水降雪型快速积污导致的输变电设备污闪机理与防治措施[J]．电网技术，2008，32(4)：1-6．Yin Qiong，Chen Yuan．Mechanism of pollution-flashover in power transmission and transformation equipments caused by rainfall or snowfall type high conductivity rapid contamination accumulation and its prevention measures[J]．Power System Technology，2008，32(4)：1-6(in Chinese)．[5] 苑吉河，蒋兴良，张志劲，等．高海拔现场标准悬式绝缘子的交流污闪特性[J]．电网技术，2009，33(5)：54-57．Yuan Jihe，Jiang Xingliang，Zhang Zhijin，et al．AC pollution flashover performance of standard suspension insulators at high altitude sites[J]．Power System Technology，2009，33(5)：54-57(in Chinese)．[6] 张志劲，蒋兴良，孙才新．污秽绝缘子闪络特性研究现状及展望[J]．电网技术，2006，30(2)：35-40．Zhang Zhijin，Jiang Xingliang，Sun Caixin．Present situation and prospect of research on flashover characteristics of polluted insulators [J]．Power System Technology，2006，30(2)：35-40(in Chinese)．[7] Li Hengzhen，Liu Gang，Liu Xiaodong．Discussion on the application of leakage current and optical sensor online monitoring equipments [C]//2008 IEEE International Symposium on Electrical Insulation．IEEE，2008：85-88．[8] 吉开俊．大气质量指数在防污闪工作中的应用研究[D]．南京：南京理工大学，2002．[9] Jolly D C，Poole C D．Flashover of contaminated insulators with cylindrical symmetry under DC conditions [J]．IEEE Trans on Electrical Insulation，1979，14(2)：77-84．[10] Cheng T C，Wu C T，Kim Y B，et al．EPRI-HVDC insulator studies part ii laboratory simulation studies[J]．IEEE Trans on Power Apparatus and Systems，1981，200(2)：910-920．[11] 陈宇强，吴光亚，田强，等．光谱法检测输变电设备盐密的实验室研究[J]．高电压技术，2001，27(5)：57-58．Chen Yuqiang，Wu Yaguang，Tian Qiang，et al．Investigation of salt density in substation and transmission line by optic spectrum in laboratory[J]．High Voltage Engineering，2001，27(5)：57-58(in Chinese)．[12] 万德春，蔡炜，宋伟，等．光技术盐密在线监测系统的研究[J]．高电压技术，2005，31(8)：33-35．Wan Dechun，Cai Wei，Song Wei，et al．Investigation on ESDD on-line measurement system using optical technology[J]．High Voltage Engineering，2005，31(8)：33-35(in Chinese)．[13] 钱茂华，崔国顺，关志成．用局部表面电导率划分污秽等级[J]．电瓷避雷器，1994(6)：12-14．Qian Maohua，Cui Guoshun，Guan Zhicheng．Study on using the partial surface conductivity to evaluate contamination level [J]．Insulators and Surge Arresters，1994(6)：12-14(in Chinese)．[14] 刘煜，王少俊，范立群．硫酸钙对ESDD贡献的定量分析与验证[J]．高电压技术，2005，31(2)：9-12．Liu Yu，Wang Shaojun，Fan Liqun．Quantitative analysis and verification on the contribution of CaSO4 to equivalent salt deposit density[J]．High Voltage Engineering，2005，31(2)：9-12(in Chinese)．[15] 张慧媛，丁扬．电网电瓷外绝缘子秽等级的确定[J]．华北电力大学学报，1997，24(4)：24-29．Zhang Huiyuan，Ding Yang．Study on determining contamination levels of grid electric porcelain external insulation[J]．Journal of North China Electric Power University，1997，24(4)：24-29(in Chinese)．[16] Ramos N G，Campillo R M T，Naito K．A study on the characteristics of various conductive contaminants accumulated on high voltage insulators [J]．IEEE Trans on Power Delivery，1993，8(4)：1842-1850．[17] IEC60815-1—2002，Selection and dimensioning of high voltage for polluted conditions，part 1：definitions，information and general principles[S]．[18] 宿志一．换流站直流绝缘子自然积污特性与直交积污比[C]//中国电机工程学会高压专委会2007年学术年会论文集．深圳：中国电机工程学会，2007：281-290．[19] 阎东，卢明，张亚鹏．500 kV荻仓线污闪故障分析[J]．高电压技术，2006，32(10)：138-140．Yan Dong，Lu Ming，Zhang Yapeng．Analysis of pollution flashover fault on 500 kV Huochang transmission line[J]．High Voltage Engineering，2006，32(10)：138-140(in Chinese)．[20] 关志成，张仁豫，薛家麒．自然污秽可溶盐构成及其对污闪电压值的影响[J]．电瓷避雷器，1989(6)：13-18．Guan Zhicheng，Zhang Renyu，Xue Jialin．Study on the influence of soluble natural contamination on the voltage of contamination flashover[J]．Insulators and Surge Arresters，1989(6)：13-18(in Chinese)．[21] 宿志一，刘燕生．我国北方内陆地区线路与变电站用绝缘子的直、交流自然积污试验结果的比较[J]．电网技术，2004，28(10)：13-17．Su Zhiyi，Liu Yansheng．Comparison of natural contaminants accumulated on surfaces of suspension and post insulators with dc and ac stress in northern China’s inland areas[J]．Power System Technology，2004，28(10)：13-17(in Chinese)．[22] Chrzan K．Conductivity of aqueous dust solutions[J]．IEEE Trans on Electrical Insulation，1987，22(3)：241-244．[23] Seinfeld，John H．Atmospheric chemistry and physics of air pollution[M]．St.Louis：John Wiley&sons Inc，1986：49-62．[24] Zhou J G，Dong G，Imakoma T．Contamination performance of outer-rib type suspension insulators[C]//Asia Pacific，IEEE/PES Transmission and Distribution Conference and Exhibition．Shanghai：IEEE/PES，2002：2185-2190．[25] 吉开俊．大气质量指数在防污闪工作中的应用研究[D]．南京：南京理工大学，2002．[26] 张鹏，贺智，高锡明．直流换流站隔离开关支柱绝缘子人工污秽试验[J]．高电压技术，2008，34(8)：1774-1777．Zhang Peng，He Zhi，Gao Xinming．Study on the artificial pollution test of isolating switch insulator of DC converter station[J]．High Voltage Engineering，2008，34(8)：1774-1777(in Chinese)．[27] 曹婉真，夏又新，电解质[M]．西安：西安交通大学出版社，1991：71-75．[28] Zhang Fuzeng，Wang Liming，Guan Zhicheng．Investigation on DC flashover performance of porcelain insulators in high altitude areas[C]//IEEE International Conference on Condition Monitoring and

Diagnosis. Shenzhen：IEEE，2008：72-376. [29] 张福增，王黎明，关志成. 高海拔地区大吨位绝缘子直流污闪特性研究[J]. 高电压技术，2008，34(6)：1089-1094. Zhang Fuzeng，Wang Liming，Guan Zhicheng. External insulation characteristic of ultra high voltage transmission line in high altitude area [J]. High Voltage Engineering，2008，34(6)：1089-1094(in Chinese). [30] Williams L J，Kim J H，Kim Y B. Contaminated insulators-chemical dependence of flashover voltages and salt migration[J]. IEEE Trans on Power Apparatus and Systems，1974，93(5)：1572-1580. [31] Cheng T C，Wu C T，Zedan F. EPRI-HVDC insulator studies part i field test at the sylmar HVDC converter station[J]. IEEE Trans on Power Apparatus and Systems，1981，100(2)：902-909. [32] Sulaiman A E，Iqbal Qureshi M. Effect of contamination on the leakage current of inland desert insulators[J]. IEEE Trans on Electrical Insulation，1984，19(4)：332-339. [33] Cheng T C，Wu C T. Communications on the deleterious effects of nitrates on insulating surfaces under HVDC conditions[J]. IEEE Trans on Electrical Insulation，1979，14(3)：171-174.

本刊中的类似文章