การติดตามการกัดกร่อนด้วยเซนเซอร์ทางเคมีไฟฟ้าสำหรับเหล็กรางรถไฟ

Corrosion monitoring with electrochemical sensor for rail steels

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Project leader	Wanida Pongsaksawad

Co-researchers

Nirut Boonchu	Pranpreeya Wangjina
Witsanupong Khonraeng	Amnuaysak Chianpairot
Ekkarut Viyanit	Junhua Dong (IMR-CAS)

The railway network in Thailand has been under extension and development in the city and across regions. The high-speed train (Thailand-China), the high-speed railway linking the 3 airports: Don Mueang-Suvarnabhumi-U-Tapao airports, and the double-tracks railway project are in construction phase. The material selection at the design stage and maintenance planning requires materials database of corrosion resistant properties of various steel types. The major route in Thailand starts from the northern and northeastern parts to the center and Eastern Economic Corridor (EEC) down to the southern peninsular. Each region in Thailand has different micro-climate and influences from Monsoon. These climate and environment have significant impact on corrosion behavior of steel. It is necessary to monitor the corrosion behavior of different types of steel by using corrosion sensor. Institute of Materials Research, China, has developed a bi-electrode sensor that has been proven to monitor the surface reaction of steel exposed to the atmosphere. This project conducted field exposure test in Thailand to validate the sensor application. One year field test data at Songkhla, Chon Buri and Nakhon Ratchasima showed corrosion rate ranking from high to low as Songkhla > Chon Buri > Nakhon Ratchasima. UIC900A had the greatest corrosion rates followed by R260 and AREMA. Corrosion ranking was in agreement with bi-electrode sensor results obtained by applying electrochemical impedance spectroscopy (EIS) polarization resistance and Tafel constant values from electrochemical frequency modulation (EFM) measurement. Accelerated corrosion test based on ISO16539 yielded significantly greater corrosion loss when sprayed equivalent amount of chloride. Corrosion ranking was not consistent with actual field test. Further study is required. It is evident that AREMA with microalloying copper and chromium exhibited similar corrosion loss as UIC900A in Songkhla environment, which is not recommended for distance within 1 km from seashore. From preliminary machine learning approach, Random Forest model could predict corrosion rates from weather parameter input at 76% accuracy. Important factors were temperature, relative humidity, exposure time, wind speed, wind direction, and rainfall, respectively. Bi-electrode sensor can be applied to rank material corrosion resistance and lifetime prediction. It is also applicable to other industries.