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Inspection and Identification of Inner-outer Defects on Oil-gas Pipeline[1]

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Abstract

The paper discussed pipeline inner-outer defects inspection and identification methods in pipeline magnetic flux leakage (MFL) inspection. Inspection vehicle got across defects in some velocity, bringing residual MFL, its signal frequency and peak value depend on defects size, defects shape, defects in inner or outer, inspected by Hall element sensors. The results of this research indicate different character of defects MFL signal is a method of inspection and identification of inner-outer defects, improving integrity assessment of defects.

Keywords: defects inspection, inner-outer defects, residual MFL

1. INTRODUCTION

Magnetic flux leakage is the most commonly used in-line inspection method for pipelines[1]. MFL technology can successfully overcome the physical and practical inspection challenges presented by transmission pipelines. In-line inspection pigs have historically been used to detect and size corrosion defects. More recently, the tools have been built to detect and size other defects, such as mechanical damage and cracks. As the same time, some questions didn't be resolved fully. Like estimate flaw size and shape and inner-outer defects distinguish and so and. Hence, many approaches are studied and tried to improve the estimation precision of defects. In this paper, inspection and identification of inner-outer defects on oil-gas pipeline will be discussed by MFL signals.

2. MAGNETIZATION ANALYSIS OF THE PIPELINE

The magnetic flux leakage (MFL) type non-destructive testing (NDT) system is widely used to detect metal losses of the underground pipe in gas (PIG) pipelines[2-4]. In the system, the sensor modules are consisted of permanent magnet, magnetic yoke and Hall sensors to detect the metal loss corrosion defect and any other damages of the oil-gas pipeline. The object pipeline is magnetically saturated by a magnetic system with permanent magnet and yokes as in Fig. 1. Hall sensors detect the stray leakage fields in the metal loss region.

In the system, a magnetization level is designed to be high enough to saturate the pipeline in order to increase the sensitivities of the systems [5-6]. And two terms sensors are used. Front term sensors between two magnet poles test MFL signals in the saturation, back term sensors is the high sensitive magnetic sensor behind the whole detector that test residual MFL as in Fig. 2. And axial assembly sensors and circumferential array sensors are employed to gain transverse and longitudinal MFL signals all together.

[1] National key Technology R&D Program in China (2006BAK02b01-05)

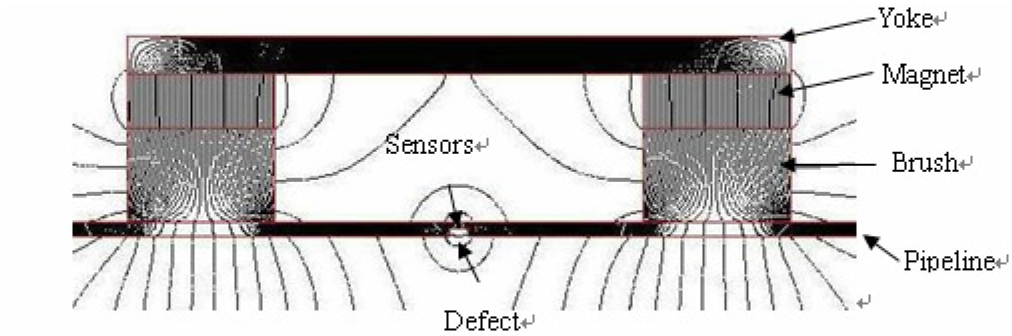

Fig. 1 Diagram of a MFL type

. All detective signals are sent to the computer by USB interface. Fig. 3 shows the variations of magnetic field according to the movement of the PIG at measured point. As the PIG passes, the magnitude and direction of the magnetic field at the measured area is set out

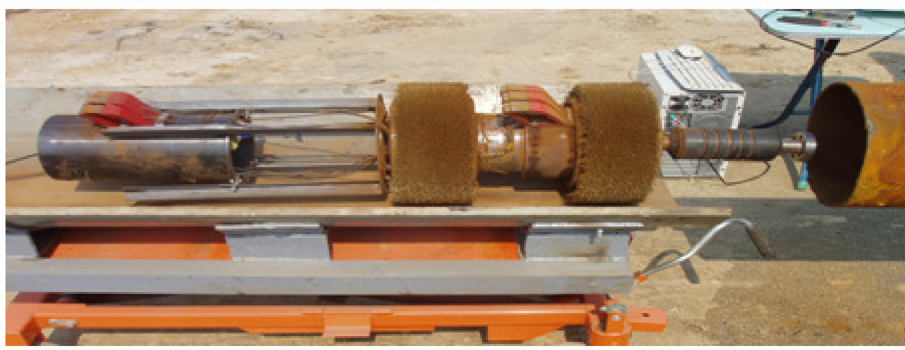

Fig. 2 Real MFL Testing Equipment

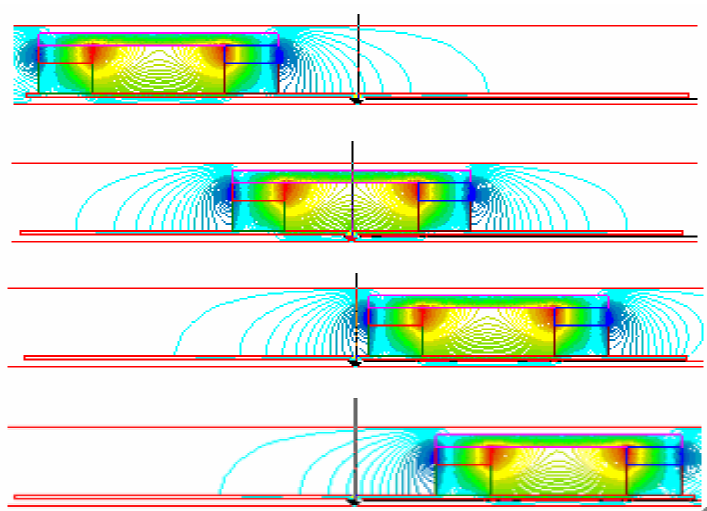

Fig. 3 Magnetic fields according to the movement of the MFL PIG

3. EXPERIMENT

For the measurement, we made a gas pipeline of 325mm diameter and wall thickness 7mm with several types of artificial defects on the pipeline inner-outer. The gouge of about 120-mm length, 2mm width, and depth varying from zero to3 mm maximum It is shown in Figure 4.

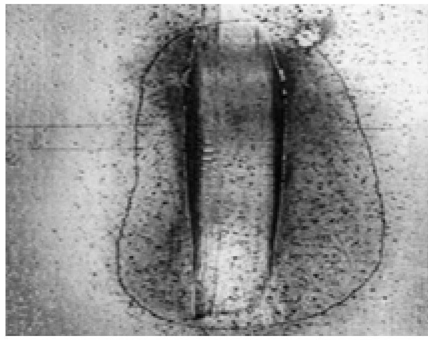

Figure .4 Camera picture of a gouge on a steel line pipe section

The shape of the flux pattern is well understood and has been reported by many workers. For every defect is symmetrical in the pipeline direction, radial signals' peak value are also symmetrical. Distance of two peaks equal to the length of the defect approximately, and peak value in correlation with the width as in Fig. 5.

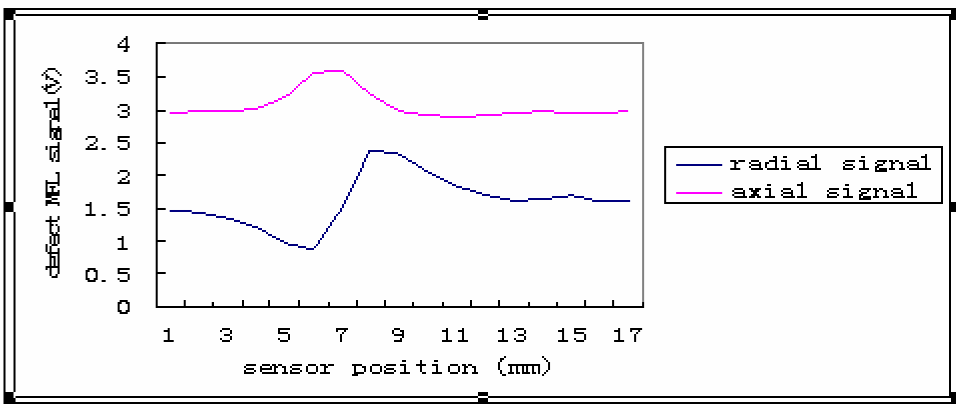

Fig. 5 one defect MFL signal

The axial and radial components of the former sensors MFL signals according to all the gouge metal loss are displayed in Fig. 6. All the radial components of the back sensors MFL signals and the former sensors MFL signals are compared in Fig. 7.Thus it can be seen that inner-outer defects MFL signals are different in radial components peak value.

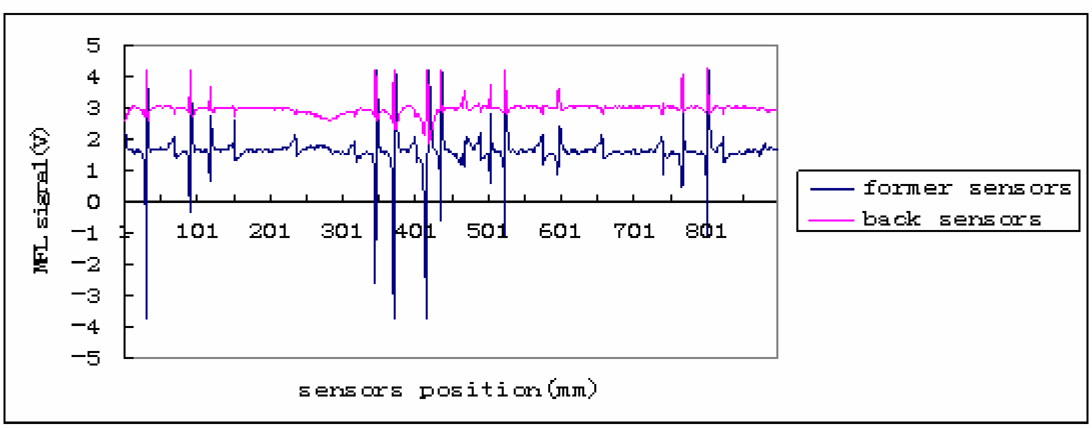

Fig. 6 one of the whole pipeline defects MFL signals

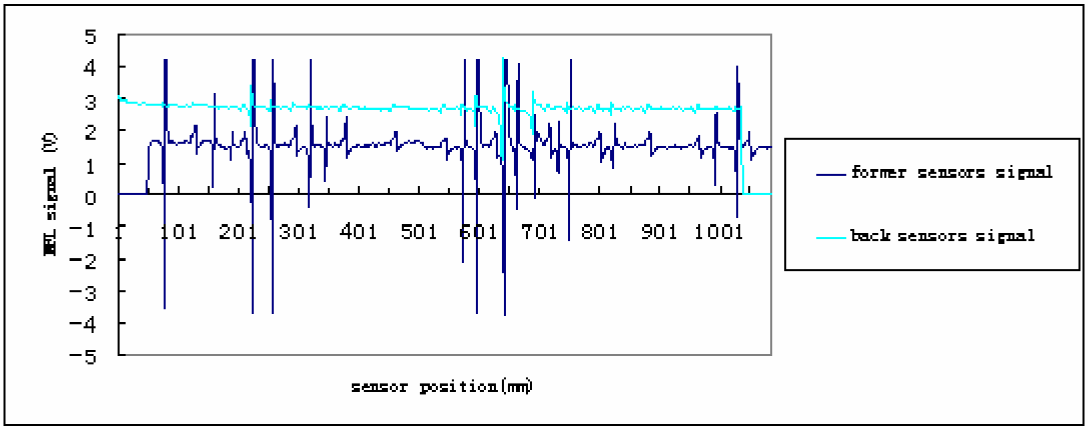

Fig. 7 MFL signals compare between former term and back term sensors

4. CONCLUSIONS

A magnetic flux leakage inspection robot equipped with two terms Hall sensors for oil pipes was developed. The experimental results indicated that some pipeline defects can be found by former sensors and back sensors and its inner-outer position, other defects still can’t be found. The MFL signals obtained depend not only on the detector and the defect but also on running conditions, such as the tester’s velocity and stress, life-off and so on. Thus, more study need be finished.

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