POLYMERIC ARMOR DESIGN OF AN IMPROVED PROTECTION TO MECHANICAL STRESSES AND FLUIDS FOR OIL GAS AND PETROCHEM (OGP) APPLICATIONS

Paul CINQUEMANI, Prysmian Cables & Systems USA, LLC, paul.cinquemani@prysmian.com
Luca DE RAI, Prysmian Cables & Systems SpA, (Italy), luca.derai@prysmian.com
Marco FRIGERIO, Prysmian Cables & Systems SpA, (Italy), marco.frigerio@prysmian.com
Paolo VEGGETTI, Prysmian Cables & Systems Oy, (Finland), paolo.veggetti@prysmian.com

ABSTRACT

Electric power cables for OGP application can be subjected to very high tension during installation, so they can get damaged by high Sidewall Bearing Pressure and by other accidental impacts. Typically, manufacturers and cable installers have used various ways to protect cables from mechanical stresses. Cable manufacturers use metal clad armor of either aluminum interlocked armor (AIA) or continuously corrugated metal armor. This paper will detail the development and evaluation of a new design of power cable that provides increased mechanical protection without the use of metallic armor while also improving overall flexibility, by a composite polymeric protection. The new design incorporates a polymer layer that has been shown to improve both the mechanical toughness of electrical power cables while providing improved flexibility compared to cables using metallic armor.
In addition, the cable design must be suitable to protect the insulated cores from the attack of hydrocarbons, oils and various fluids which are typical of the OGP industry applications. The design proposed is providing the necessary protection to fluids by a special polymeric layer, combined with a metal thin foil, without all the disadvantages of the metal clad armored cables (weight, stiffness, difficult termination etc.).
The data presented supports that polymeric armor provides 5 times better impact performance than metallic armored products, and provides a fluids protection equivalent to the metal clad armor design. This allows installers and customers to install cables for longer distances without the need for expensive splices which also affects cable reliability; the experience on the installation field by a few customers is already confirming the great benefits of such new cable.

INTRODUCTION

The NFPA National Electrical Code (NEC) clearly defines the applications where Metal Clad Cables (Type MC) are required to be installed or may optionally be used in the occupancies covered therein [1]. In many other locations and applications metal clad cable may be used as a beneficial option such as conduit replacement or as an alternate design when greater mechanical abuse resistant cable is desired by the end user.

In fact it has become quite common for multi-conductor Type MC power cables to be installed as the cable of choice in many industry applications, even where metal clad is not required by the NEC. The popularity arises from the diverse installations and locations where additional mechanical abuse resistance is beneficial to the end user. However, one major drawback to installation of conventional metal clad cables is the limitation of maximum lengths that can be pulled due to sidewall bearing pressure contraints.

Conventional Type MC encompasses basically two types 1) continuous corrugated aluminum sheath and 2) aluminum interlocked strip armor (AIA) that is also provided to a lesser extent with galvanized steel strips (GSIA).

The continuous corrugated aluminum sheath is typically produced by forming a flat aluminum sheath circumferentially and longitudinally around a cabled core whereas it is then slit to proper width, edge welded and lastly corrugated. The profiles of the corrugations are specifically designed to provide optimum bending characteristics. This design results in a very rigid armor with limited sidewall bearing pressure (SWBP) capabilities during installation. Industry recommendations vary between 1000 to 1500 pounds per foot of bend-radius.

The interlocked aluminum strip armor is typically produced with two (2) predetermined flat strips that are edge formed, shaped and helically applied in a single pass resulting in tape armor where each strip is interlocked with each adjacent strip. This armor results is a somewhat more flexible armor compared to the continuously corrugated aluminum. Due to the strip interlocking this armor lacks an impervious barrier and cannot protect the cable core against aggressive chemicals or moisture. This design is also further limited in SWBP to industry recommended values of 800 pounds per foot of bend-radius.