

Subject: ROXAN Sealant System

(Written and submitted by ArcelorMittal)

Roxan is a high-performance patented water-tightening system for steel sheet piling. **The sealant product used is the Adeka P-201, a mono-component mastic made from urethane pre-polymers.**

The Roxan system is fully compatible with most polluted soils and the physical and swelling properties are not affected, so that there is almost no restriction to the use of the system. In case of need, the compatibility with the chemical constituents of the contaminated soils can be verified.

It is evenly applied in the steel sheet piling interlock in a thin layer, using an airless or extrusion pump. Good experience has been made with the US-made Graco Bulldog pump type 55:1. For proper spreading of the product in the AZ interlocks, the ArcelorMittal patented template will be put at the contractor disposal, free of charge. (Please also refer to annexed pictures). When the sealing compound has been applied in said sheet piles, the template has to be returned. The device cannot be used for applying a sealing compound to any other sheet piles.

It is recommended to apply the product under shelter at ambient temperatures. In order to improve the adherence of the product, the interlock chamber is cleaned with a steel wire brush and compressed air jet. The interlock chamber should be free of standing water and shall be free of coating (please refer to Impervious Sheet Pile Wall Part 2). Once polymerized, the product adheres extremely well to the steel and the surface of the polyurethane is smooth allowing the interlock to slide down easily during driving. The adherence on steel is good and measurements (pull off tests) realized by the ArcelorMittal Research Department gave the following results;

- applied and polymerized at 20°C, (68°F): 12 kg/cm² (171 lb/in²)
- applied and polymerized at 70°C (158°F): 15 kg/cm² (213 lb/in²)

Average consumption is approximately 0- 15 liters per meter of interlock, or 90 feet per gallon. Average productivity is approximately 200 meters per 8 hours shift, that's to say 650 feet.

At the job site, just before installation, a mix of water and liquid soap is applied with a brush to the sealant for lubrication to eliminate any risk of stripping.

Prolonged contact with standing water during transportation and/or storage would lead to premature swelling and loss of adherence of the product. That's why it is recommended to carry out these operations with the opening of the treated interlock (female interlock recommended) facing downwards. Covering with a plastic sheet is not recommended (condensation). Under these conditions storage periods of up to 3 months can be allowed.

Impact driving, vibratory driving or jacking can do installation of the sheet piles. In case a vibrator is used, care must be taken that the interlocks don't exceed 130 degrees centigrade, or 270 degrees Fahrenheit. Adequate guiding shall be provided in order to avoid out of plumbness (1% to be considered as a maximum value).

The sheet piles are installed with the empty interlock as the leading interlock. Before threading the Roxan treated and lubricated trailing interlock of the following sheet pile, the interlock cleaning tool, as provided by ArcelorMittal for expelling soil out of the leading interlock, is inserted. **Once the product is in contact with the water table, the said sheet pile should be driven to grade within 2 hours to avoid**

expansion of the sealant.

If the above recommendations, as procured by ArcelorMittal, for the installation of the sealant system as well as for storage and driving will be followed, an inverse joint resistance $p = 3 \times 10^{-10}$ m/s (9.8×10^{-10} ft/s), as specified in the brochure entitled "Impervious Sheet Pile Wall - Part 1" can be assumed for the design approach.

The inverse joint resistance has been determined out of 200 field tests where the discharge through the joints (sealed with Roxan) was measured as a function of the applied pressure drop using a special test apparatus (See "Part 1"). The applicable safety factor on that value should nevertheless be carefully chosen in consideration of the scattering of the data as well as of the risk inherent to the project.

Despite the fact that the Roxan system has been intensively tested ArcelorMittal and/or Adeka Ultra Seal can in no case be held liable for damages resulting from an inadequate or improper use of it.

It is obvious that a good result is only obtained when significant flows around the pile toe are avoided by sufficient embedding into an impervious layer.

For more information or our videotape on the sealant installation, please call your local Adeka Ultra Seal Representative (National Number 800.999.3959) or David Borger (Skyline Steel) at 973.795.1475.
www.skylinesteel.com

**DEVELOPED AND PATENTED BY ARCELORMITTAL FOR USE ON ARBED AZ STEEL SHEET PILES
(marketed by Skyline Steel Corporation)**

**1.1.2 Water-swelling product
(Roxan™ System) (Adeka Ultra Seal P-201)**

1.1.2.1 Features of the product

Composition:	normally urethane prepolymer
Density at 20°C:	1.22
Inflammation point:	500°C
Maximum expansion:	<ul style="list-style-type: none">• continuous immersion in drinking water: 115%• in sea water: 90%• alternate cycles drinking water: 115%• sea water: 90%• no expansion in oil• expansion in alkaline salts: identical to drinking water
Colour:	normally light grey

These features are only given as an indication and can be modified by the supplier as required.

1.1.2.2 Packaging

The product is supplied in cartridges of 320 ml or in barrels of approximately 15 l for extrusion.

1.1.2.3 Conditions of application

The behaviour of the water-swelling product when it is installed is set out below:

- application on a surface covered with standing water: impossible
- application on damp metal (dew point): excellent
- application on metal at -10°C: delicate or critical
- application on metal at +5°C to +70°C: excellent
- polymerization in rain: delicate to critical
- polymerization in UV light: excellent

1.1.2.4 Durability of the product in different environments

ie durability in the installed steel sheet piling:

- water with pH 3.5 to pH 11.5: excellent
- sea water: excellent
- mineral oil: excellent
- petrol: excellent
- crude oil: excellent

1.1.2.5 Consumption

Application into an open interlock (**Figure 6**): consumption approximately 0.15 l per metre of interlock.

**1.1.2.6 Installation of seal at the factory
(Figures 7, 8 and 9)**

The application of the water-swelling product is made preferably at the factory and must be carried out to comply with the following requirements:

- the interlock must be dry; possible slight humidity is permitted;
- laying out the piling in a perfectly horizontal position is not essential;
- so that the product can adhere in the interlocks, recently rolled piles need to be cleaned with a jet of compressed air. In the event of the presence of corrosion in the interlocks, cleaning with a steel wire brush and/or high-pressure water jet is necessary;
- positioning the product by extrusion and spreading the product using a special template (ProfilArbed patent LU 88397) which distributes the product properly in the interlock;

Take care!! Spreading using the special template is **essential** to ensure the sealing of the interlock.

- filling the interlocks taking into account the direction of driving;
- if the piles are supplied in single units: fill one free interlock per single pile (**Figure 7**);
- if the piles are supplied in units already fitted together (doubles):
 - * either fill the intermediate interlock before they are fitted together, together with one free interlock (**Figure 8**);
 - * or weld the intermediate interlock and fill one free interlock (**Figure 8**).

It should be noted that it is possible to crimp the piles once they have been sealed and threaded together.

1.1.2.7 Installing the seal in situ

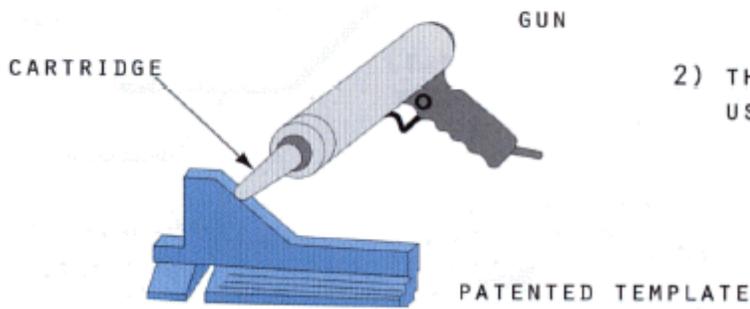
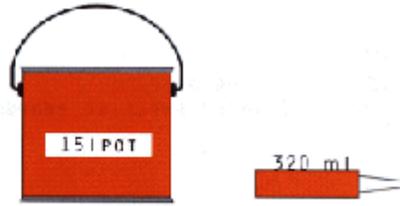
Application of the water-swelling product in situ is not advised unless the work can be carried out under shelter. It must then be carried out to comply with the same requirements as for application at the factory (with assistance from ISPC's Technical Advice Service).

Call 800.999.3959 and request ProfilArbed catalog "The Impervious Steel Sheet Pile Wall part 2: Practical Aspects" for full information.

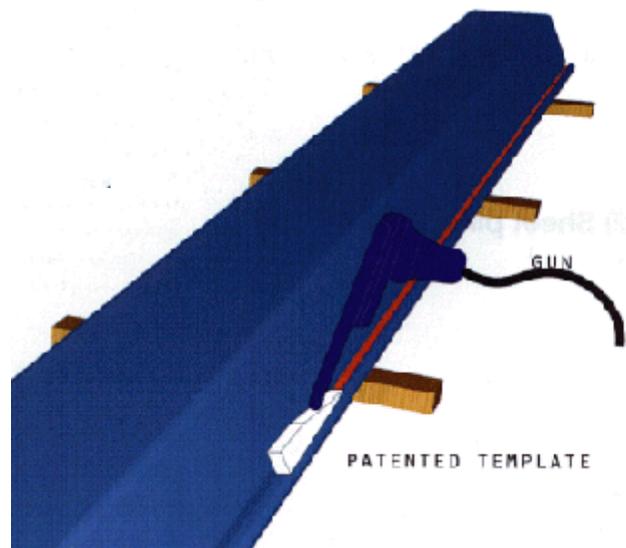
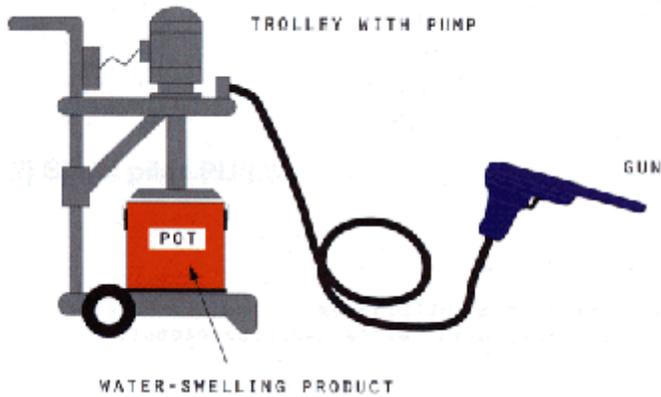
Illustrated description of the feeding of a water-swelling product

(Adeka Ultra Seal P-201)

- 1) SUPPLY OF WATER-SWELLING PRODUCT IN 15l POT OR IN 320 ml CARTRIDGES



- 2) THE PRODUCT IS EXTRUDED USING A PNEUMATIC PUMP OR GUN.



PROFIL ARBED
TEMPLATE



PRESSUREGUN
ATTACHEDTOTEMPLATE

INJECTINGP-201
THROUGHTEMPLATE



ROXAN SYSTEM APPLICATION GENERAL COMMENTS

P-201 Container size: 3.17 gal (12 liter) pail - 320 ml cartridge

Viscosity of Adeka Ultra Seal : **P-201 = 15,000 cps** ; Viscosity at 25 degrees C ; Type E 5rpm ; 150 PaS; 1PaS=100mPaS=100cps

Apply through pump at approximately 50 psi (3.5 BAR). Graco King (55:1) and Graco President (45:1) have been used successfully.

Apply at above 40 deg. ambient and material temperature.

Clean interlock thorough with wire brush. Blow out with compressed air.

One gallon of P-201 will cover approximately 90 feet of interlock.

Approximately 650 lineal feet can be treated in one eight hour shift.

Inspect interlock after treatment and touch up manually if necessary (use brush).

Clean equipment with MEK (methyl ethyl ketone) or methylene chloride (**check and use manufacturers precautions when handling this solvent**).

Allow 2 days for complete polymerization.

Piles are best stored with treated interlock in an inverted position. **Keep dry during storage and transporation.**

Drive with untreated interlock leading.

Driving must be complete within 2 hours once pile is in water (ground water).

Piles can be driven with impact hammer or vibratory drivers. Interlocks should not exceed 270 deg. F. during driving process.

Panel driving can be accomplished if the ground water level is low and piles can be staggered. Once in ground water, they must reach final level within 2 hours.