# A New Fabric Material with Anti-scaling Properties for Security Filtration in Bayer Process

**Luc Parent[1], Alain Boivin[2], Sandrine Forsoni[3] and Nicholas Turgeon[4]**
1. Innovation Manager Process Filtration
Sefar BDH, Saguenay, Canada
2. Principal Adviser Bayer Process
4. Bayer Process engineer
Rio Tinto, Saguenay, Canada
3. Industry Manager Minerals
Sefar, Thal, Switzerland
Corresponding author: Sandrine.forsoni@sefar.com
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**Abstract**

The security filtration in the Bayer process presents one of the most challenging environments for filtration fabrics. Almost all materials exposed to the hot, corrosive solution—supersaturated with alumina hydrate—become coated within hours by a hard precipitate known as hydrate scale. Its formation not only poses a significant challenge for tanks and piping maintenance and cleaning, but it is particularly problematic for filter media, as it rapidly clogs the pores. Even with regular caustic cleaning, filter bags become obstructed primarily due to scaling and require frequent replacement. Over the years, various filter media have been tested to resist scaling, but with limited success. However, a newly developed material from Sefar has demonstrated outstanding resistance to scaling. One of the key challenges in evaluating new fabrics in a plant environment is data analysis. To accurately assess the performance of the new fabric, a statistical approach is required to isolate the effects of cloth scaling from other influencing factors. This paper presents the production improvement of 7 % achieved with the new fabric and details the data treatment method used in the plant evaluation.

**Keywords:** Bayer, Alumina, Scale, Filtration, Fabric.

## 1. Introduction

Scaling is a major challenge in alumina production because of the buildup of mineral deposits, primarily from tricalcium aluminate, sodium aluminate and other impurities, on equipment surfaces [1]. This buildup reduces heat transfer efficiency, clogs pipelines, and increases energy consumption. Frequent shutdowns are needed for cleaning and maintenance, leading to costly downtime and reduced productivity. Scaling also hampers flow at security filtration, gradually clogging fabrics resulting in short lifetime. Prevention of scaling is not an easy task, even PTFE parts, one of the best-known non-sticking materials, are scaled over time. It is a challenge to find a new non-scaling material and also to evaluate its effect in a plant operation in which conditions can vary within minutes.

A new fabric called X-Treme made of a material that was never tested before in Bayer liquor, according to our knowledge, was developed to delay scaling. The fabric is made of a polyolefin base polymer with a special treatment. In order to evaluate its performance in regards of scaling it was compared to our best material resistant to scaling. The incumbent fabric of reference, called X-Scale, is a polypropylene base fabric with a fluorocarbon coating. The production of the X-Scale will be stopped soon following the PFAS ban. The two fabrics have exactly the same weaving style, same number of threads in both direction and the same yarns diameters. Figure 1 shows a scanning electron micrograph of the X-Scale and X-Treme fabric surfaces.

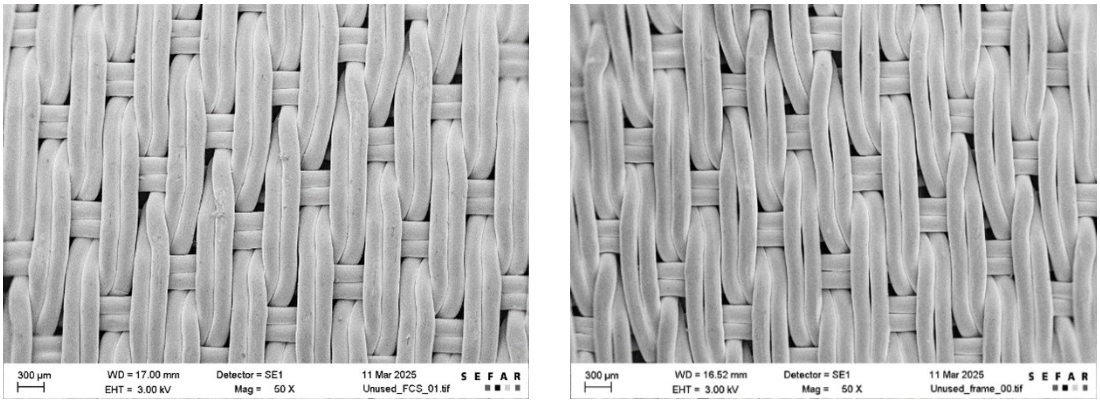


**Figure 1. Scanning electron micrograph of the X-Scale (left) and X-Treme (right).**

The scaling resistance is evaluated indirectly by measuring the filtration rate variation of fabrics over time. The general equation of filtration rate by surface area is given by:

$$\frac{dV}{Adt} = \frac{\Delta p}{\mu(R_E + R_C)} \tag{1}$$

where:

$dV$ Volume variation, m3/h
$A$ Surface area, m2
$dt$ Time variation, h
$\Delta p$ Pressure variation, kPa
μ Viscosity
$R_E$ Equipment (Support, frame, fabric) (resistance,
$R_C$ Cake resistance,

The challenge is to measure a variation in the resistance of the fabric within a complex and time-varying industrial process. Equation 1 needs to be detailed further in order to better reflect reality. Thus, Equation (1) becomes:

$$\frac{dV}{Adt} = \frac{\Delta p}{\mu\left[R_{c(t)} + \Delta R_{c(t+1)} + R_{e(t)} + \Delta R_{e(t+1)} + R_{F(t)} + \Delta R_{F(t+1)}\right]} \tag{2}$$

where:

$R_F$ Fabric resistance,
$\Delta R_{c(t+1)}$ Cake resistance variation over time
$\Delta R_{e(t+1)}$ Equipment (Support, frame) resistance variation over time
$\Delta R_{F(t+1)}$ Fabric resistance variation over time

The goal of our tests is to demonstrate that the X-Treme fabric is less prone to scaling. To achieve this, we need to measure the change in resistance $\Delta R_{F(t+1)}$ for both fabrics.

To accurately assess the intrinsic resistance of the fabric, the methodology assumes that all auxiliary resistances remain uniform across every filtration cycle within the test duration. Empirical chemical and temperature data confirm that slurry viscosity remained essentially constant throughout. Furthermore, by enforcing a fixed filtration time, the cake layer consistently attains the same thickness each cycle, allowing the cake resistance to be treated as invariant. These assumptions—constant viscosity and cake resistance—significantly streamline the analytical modelling of filtration performance. The variation in equipment resistance is primarily attributed

## 4. Reference

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