

HYDREX® P to Improve Energy Saving and Sustainability



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HYDREX® 

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Evonik Silica Product HYDREX® P Can Reduce Energy Consumption and Improve Sustainability in the Paper Industry

There have been dramatic changes in the energy sector during past year and half, these changes have been seen at all regions and impacting Europe the hardest. Current energy prices have a significant impact on our daily life, not only as household expenditures, but also as an increase in industrial costs and reduced business competitiveness. Overall, the energy segment today is in very volatile state with significant concern on energy availability.

Paper manufacturing is considered as high energy intensive industry and current energy prices are having a serious impact for all industrial paper applications. Some paper producers have been forced to limit their operations due to high energy cost and we are already seeing production line closures as a direct result of this.

Sustainable development has become one of the focus areas in the paper industry as output growth needs to be done using less energy and generating less emission in the future. Below are several facts related to the state of the paper industry:

- Pulp and paper industry is responsible for about 6% of the world total industrial energy consumption, being the fourth largest industrial energy user worldwide.
- While global paper output increased 3% between 2010 and 2019, the sector's global energy use rose by only ~ 0.5%, indicating a decoupling of energy use from production.
- While paper and paperboard production is expected to expand 1.5% annually to 2030, increases in energy use in the sector need to be limited to 0.5% per year to align with the Net Zero Emissions by 2050 scenario.

Finding the balance between sustainability goals and current energy sector development is a challenging function. EU region has set clear targets for lower emission during next decade:

- EU is committed to a 55% reduction in GHG emissions by 2030 compared to 1990 levels. In addition, the EU's objective is to become the first climate-neutral continent by 2050.
- Transport is responsible for around a quarter of EU GHG emissions.
- Started in 2015, the carbon trading volume was 1.2 billion tons in 2021 and it reached historical high at 99.1 EUR/ton in August 2022.

HYDREX® P Makes Lightweighting Possible in White Board Grades and Leads to Energy Saving and Improved Sustainability

Evonik Operations Business Line Silica offers a wide product range of precipitated silica and silicate products, fumed silica and fumed silica dispersion materials which are used in paper and board manufacturing applications.

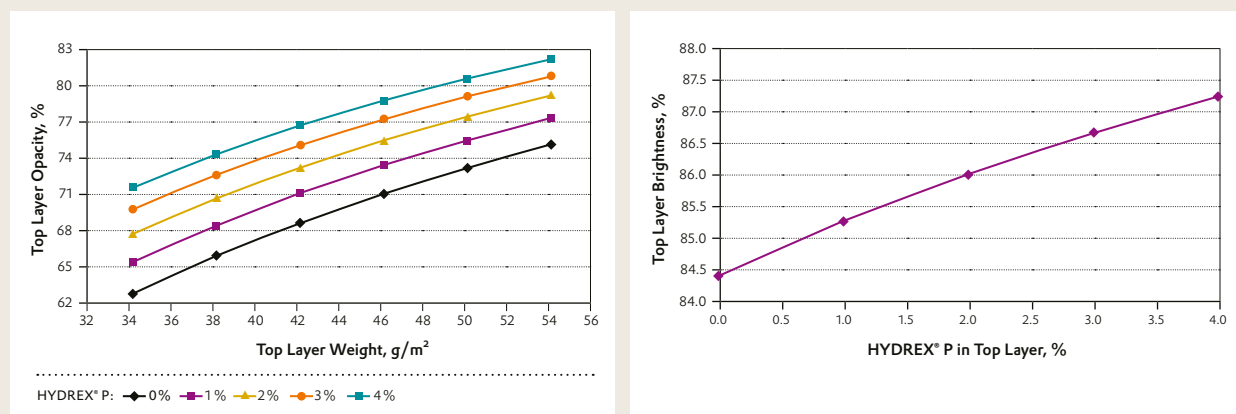
HYDREX® P, silicate-based product is widely used in different paper and board applications. One of the key product features is that HYDREX® P can support paper and board industry need for lowering energy consumption through lightweighting and the same time improving sustainability.

The example below is related to white packaging and graphic board where basis weight is 250 g/m². Board lightweighting in this application has been achieved with low

HYDREX® P amount while maintaining optical properties like ISO brightness and opacity. Similar lightweighting is possible in other paper grades where sheet bulk properties are important.

This example demonstrates benefits of lightweighting implemented in 250 g/m² white packaging and graphic board. Top-ply weight in this example is 54 g/m². With 1–2% HYDREX® P content top-ply weight can be reduced by 5.0–8.7 g/m² while maintaining the original ISO brightness and opacity levels.

Figure 1
Effect of HYDREX® P on top pulp layer brightness and opacity



Consequently, 5.0–8.7 g/m² lightweighting in white packaging and graphic board grades results in reduction in bleached cellulose fiber usage and generates savings of approx. 1.300.000–2.200.000 EUR per every 100 KMt of the board produced.

Calculation model below utilizes market prices for pulp in the fall of 2022.

Figure 2

Example of cost saving potential when HYDREX® P is used for packaging and graphic board lightweighting

HYDREX® P Dosing	0%	1%	2%
White Top Layer Weight (g/m ²)	54.0	49.0	45.3
HYDREX® P usage per FBB ton and effects on chemical/mechanical pulp consumption			
BHKP (kg/ton)	0	-22.0	-38.4
Mechanical pulp (kg/ton)	0	+20.0	+34.8
HYDREX® P (kg/ton)	0	+2.0	+3.6
Estimated savings; USD/100 000 t	-	1.300.000	2.200.000

Assuming that FBB is 250 g/m²

Assumed raw material prices: Bleached hardwood kraft pulp (BHKP); 1.350 USD | Unbleached mechanical pulp; 700 USD | HYDREX®; Standard Price

Reduction of energy consumption and environmental impacts have become the important goals for the pulp and paper industry in the current environment. Lightweighting supports these goals by offering an option to save at least 5% in energy cost in paper applications as demonstrated in the example below. Part of the reduced energy consumption is related to lower steam demand in production where it can be typically reduced by 10 to 20%.

Energy savings need to be studied on a case-by-case basis since each production line has its own specific features and different pulps and basis weights might be used. In those cases, the Applied Technology team of the Paper Industry Segment of Evonik Industries can support with these estimates and investigations.

Figure 3

Paper Lightweighting decreased energy consumption and carbon footprint

Estimation	21% Ash 0% HYDREX®	19% Ash 2% HYDREX®	19% Ash 2% HYDREX®	19% Ash 2% HYDREX® + Dyes
Grammage, g/m ²	80.0	80.0	76.5	76.0
Thickness, µm	125.3	130.8	125.3	124.3
Y-value	83.9	84.5	84.5	83.9
Opacity	93.5	94.2	93.7	93.9
Printing area, m ²	12500	The same printing area		12500
Fiber content, kg	790		755	
Filler content, kg	210		200	
Total weight, kg	1000		955	
Energy consumption, kWh	3000*		2865	
CO₂ eq, kg	942**		900	

HYDREX® P 10-20% reduction in steam consumption

5% energy saving possible with HYDREX® P

*https://www.energypartnership.cn/fileadmin/user_upload/china/media_elements/publications/2021/Technical_Guideline_Energy_Efficiency_Pulp_and_Paper_EN.pdf

**https://www.researchgate.net/publication/340492627_Life_Cycle_Carbon_Footprint_Analysis_of_Pulp_and_Paper_Grades_in_the_United_States_Using_Production-line-based_Data_and_Integration

Packaging Material Lightweighting with HYDREX® P Makes It Possible to Reach Low Carbon Logistic

Lightweighting with HYDREX® P is applicable to most white packaging and graphic board grades. This lightweighting offers a solution for low carbon transportation where every kg of carbon emission reduction counts. For example, in EMEA region transport is responsible for around a quarter of the EU's total GHG emissions.

3.5 grams weight cut in 250 g/m² white packaging board reduces 20 MT shipment weight to 19.72 MT and consequently contributes to 31 kg CO₂ reduction over 1000 km transportation distance.

The model used for greenhouse gas calculation purposes in logistic is shown in figure 4 link. Factors are converted to metric units:



Figure 4

Packaging board 3.5 g/m² weight reduction with HYDREX® P

Distance	Weight	Total MT-km	Emissions Factor	Total Emissions per 20 MT
1000 km	20.00 MT	20000 MT-km	110.9 Grams of CO ₂ /MT-km	2.218 MT CO ₂
1000 km	19.72 MT	19720 MT-km	110.9 Grams of CO ₂ /MT-km	2.187 MT CO ₂

Greenhouse Gas Calculation

Greenhouse Gas Emissions = D x W x EF

D = Transfer **distance** of shipment in kilometers

W = Shipment **weight** in kilograms

EF = Specific **emissions factor** (110.9 grams of CO₂/MT-km)

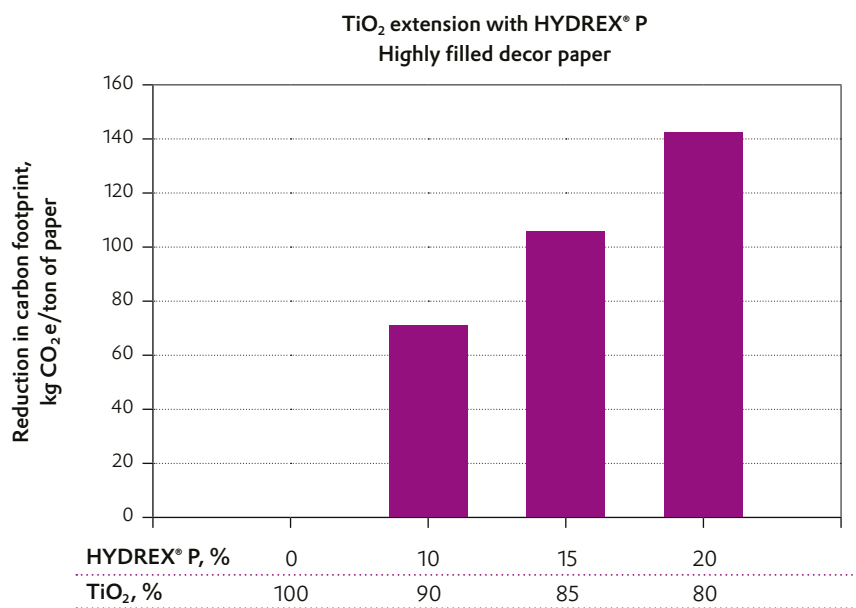
Decreasing 250 g/m² white packaging board weight by 3.5 grams provides 388 kg reduction in CO₂ emissions when transporting 1 Mio. m² packaging board materials over a distance of 1000 km.

HYDREX® P Will Reduce Paper and Board Carbon Foot-Print When Used in TiO₂ Replacement

HYDREX® P product is suitable either for total or partial TiO₂ replacement in paper and board application. How high TiO₂ replacement level can be reached depends on targeted paper grade and its required technical properties. Total replacement is possible in some paper applications, for example, in thin printing papers. Partial replacement in white decor paper is shown in the example below.

- Titanium dioxide is mainly used in impregnated paper grades, but also in thin-printing papers to improve their optical properties.
- The downside of using titanium dioxide, in addition to its high price, is the excessive global warming potential of the titanium dioxide production.
- HYDREX® P has a significantly lower Global Warming Potential.
- Titanium dioxide extension with HYDREX® P will reduce the level of carbon dioxide released into the atmosphere.
- For example, a mix of 90% titanium dioxide with 10% HYDREX® P in highly filled décor paper reduces carbon footprint by 71 kg of CO₂e per ton of paper, over 5% reduction if compared to the paper made only with titanium dioxide.
- HYDREX® P is generally recognized as safe material in food contact applications.

Figure 5
Reduced CO₂ footprint in décor paper production



NOTE! Calculation is based on high ash décor paper grade with TiO₂ (chloride process) and HYDREX® P powders

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The Silica specialists at Evonik – Inside to get it right.