



## High Tenacity Polyester for Offshore Mooring Ropes

**What is the future for the high tenacity  
fibers for mooring systems ?**

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## High Tenacity Polyester for Offshore Mooring Ropes

- Invariably, every manufacturer of fiber ropes faces the following questions when he receives his raw material: why is it that I can't attain the same properties of title and tenacity as informed in the conformity certificate from supplier?
- Obviously, when you have a good quality control in the inspection process of raw material, it is possible to narrow down the results with fair (reasonable) satisfaction.



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- However, seeking to exceed them may be uphill battle. Lets to see the following:



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- There is a large number of variables but this is hardly the time and the place for this discussion – which, I'm sure, would certainly yield an interesting study on its own.
- Yet, we would like to highlight some relevant points. The rope manufacturer will always be in disadvantage no matter how well he succeeds in reproducing, in his test laboratory, the same standard atmosphere adopted by the yarn manufacturer.



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## **High Tenacity Polyester for Offshore Mooring Ropes**

- **First of all, because – for good or for bad – the yarn bobbins undergo impacts throughout transport and are exceedingly handled. Although tested by a qualified technician, they do not receive the same treatment and acuity as in a lab prepared and fitted to carry out that kind of analysis specifically. The circumstances and skills involved are diverse.**



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- For this reason, we wish to clarify that the analysis curves and results which we present below represent a small sample of our inference and effort in attempt to reproduce the best performance (titer, tenacity, elongation, modulus and yarn-on-yarn abrasion) of the raw materials that are part of this study.



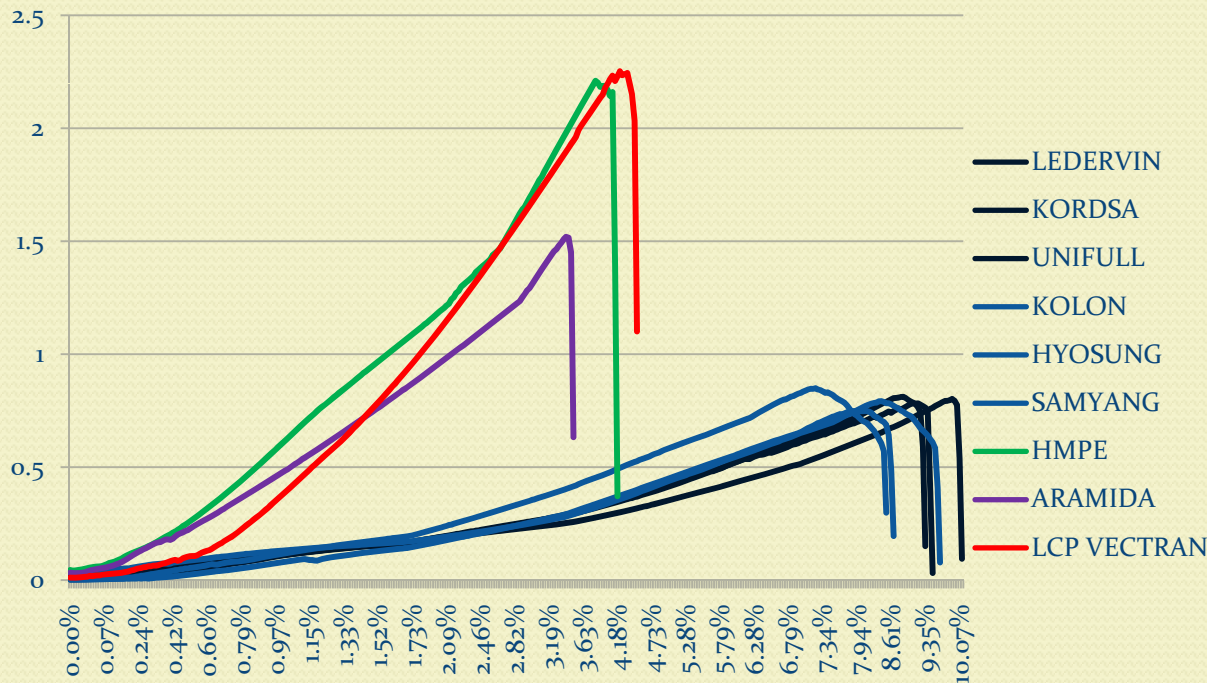
## High Tenacity Polyester for Offshore Mooring Ropes

SPECIFICATION	Kordsa	Hyosung	Unifull	Kolon	Samyang	Ledervin
TITER SPECIFICATION	2221 - 2263	2200 - 2288	2180 - 2300	2200 - 2280	2200 - 2333	2200 - 2280
ELONGATION AT BREAK MAXIMUM	16,7	15,0	16,0	14,5	16,0	16,0
TENACITY (N/tex) (MINIMUM)	0,78	0,85	0,78	0,83	0,78	0,83



# High Tenacity Polyester for Offshore Mooring Ropes

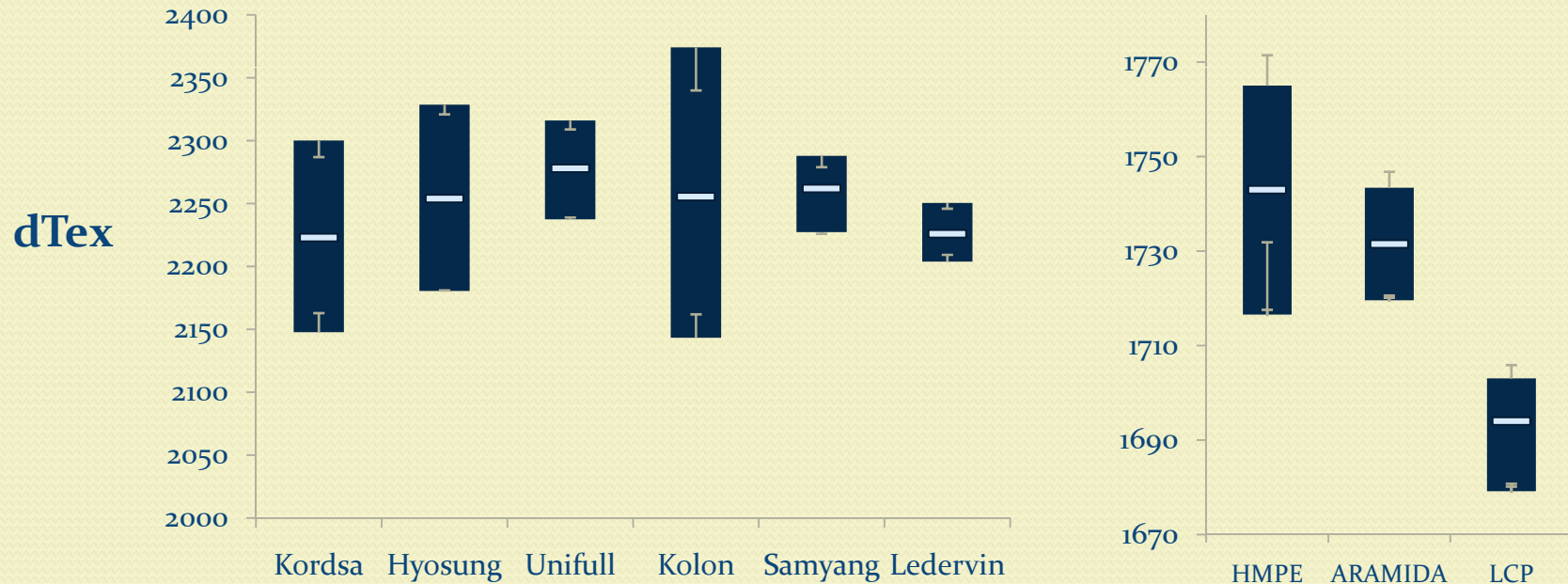
Tenacity (N/Tex) X Elongation %



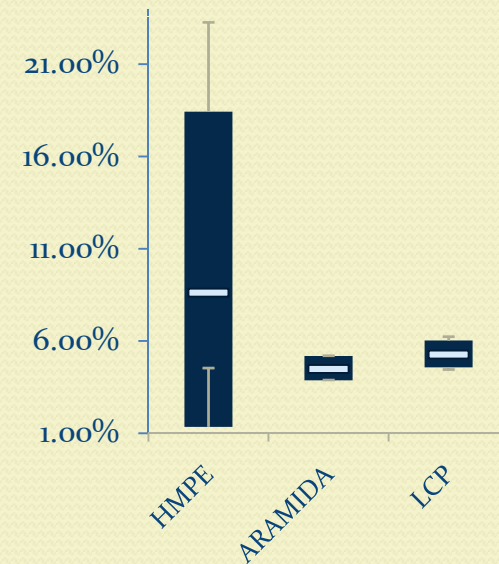
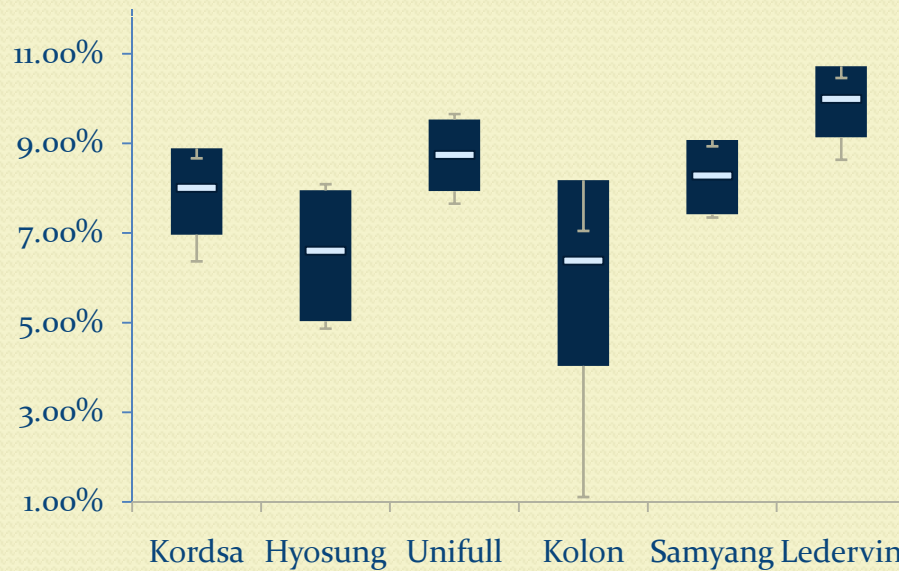
Modulus (N/Tex) (30% MBS)

Ledervin	5,1
Kordsa	7,1
Unifull	6,6
Kolon	13,4
Hyosung	9,8
Samyang	7,4
HMPE	26,7
ARAMIDA	27,9
LCP	47,6

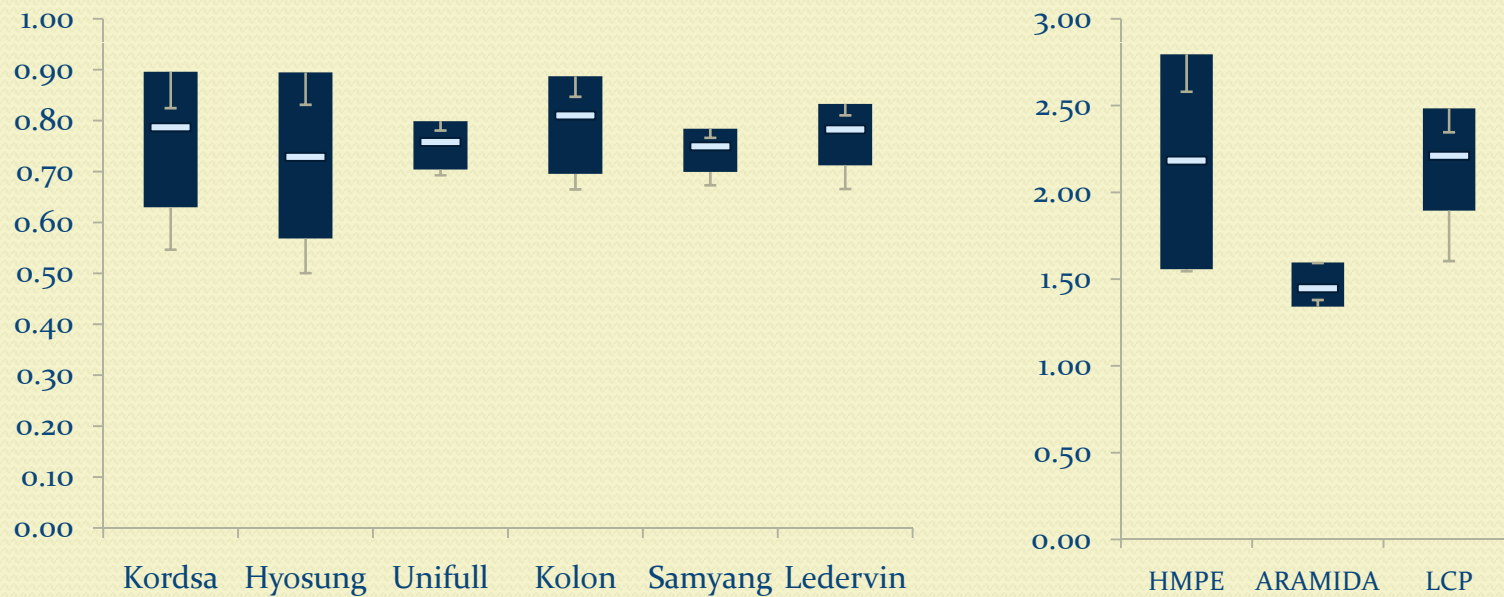
## Dispersion of the Titer



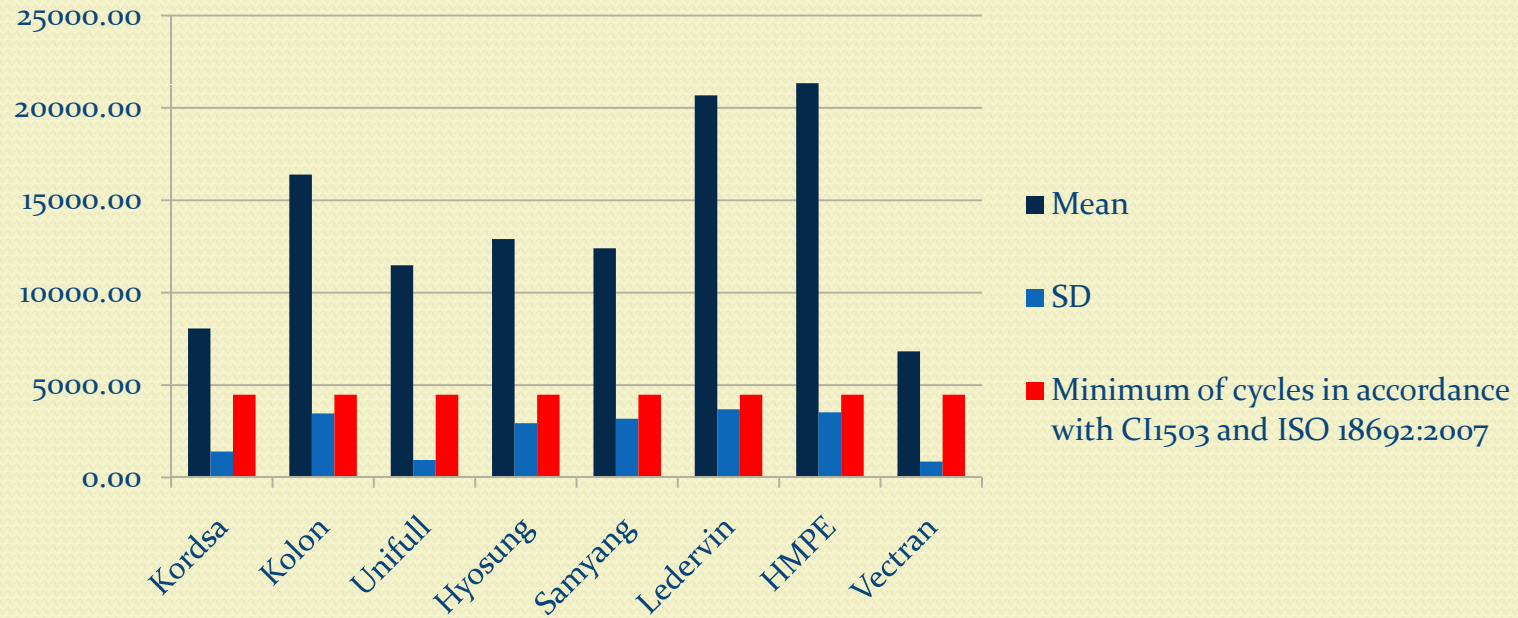
## Dispersion of the Elongation at Break (%)



## Dispersion of the Tenacity (N/Tex)



## Yarn on Yarn Abrasion



Load: 560 cN / 25,46 mN/tex



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- **CONCLUSIONS**
- **The idea of reaffirming what is already known about the efficacy of polyester in deep and ultra-deep water applications could seem redundant.**
- **In terms of technological development, it is important to acknowledge that, up now, polyester has proven to have the best technical and economical option for this segment. Everything seems to point polyester as the product of choice for the anchoring market in the foreseeable future.**



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- Evidently, the good and necessary practices of R&D lead us to the study of more efficient alternatives in the fibers market. In other words, research points the way towards the need to manufacture ropes that allow for reduction in diameter as the tenacity of their fiber is increased (enhanced). This will not only enable easier handling but, above all, allow for greater rope length on the traditional and restricted spools on tugboats utilized in the more and more challenging deployment of anchoring ropes.



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- **As contradicting as it may seem, we understand that new fibers must evolve in a gradual pragmatic way if they are to be successful. Let us think about the following example: what good will be a fiber that displays five – fold tenacity as compared to polyester and very high stiffness modulus when, at the same time, the fiber presents high creep and limited production scale / high unit cost that hinder their market penetration?**



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- **The most appropriate way, as we see it – is to manufacture stiffer ropes that are operational in ultra-deepwater. So, a fiber with elastic modulus and tenacity superior to current high tenacity polyester offering.**
- **A combination of large production volumes and competitive yarn manufacturing costs – will have a significantly attractive potencial in new anchoring projects.**



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## **High Tenacity Polyester for Offshore Mooring Ropes**

- **There is a significant room for improvement on the polyester yarn supply by optimizing the critical mechanical properties such as modulus, tenacity, elongation in order to improve the final rope performance.**
- **Lowering the coefficient of variability CV of titer, modulus, and tenacity and other variables in rope manufacturing will also improve rope performance by reduction of “weak links”.**