Royal Netherlands Institute for Sea Research

# Cable trials
# NIOZ Marine Technology dept

24 November 2009

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- Since 1978 NIOZ has used Aramide cables. One of the reasons to use an Aramide cable was and is the weight of the cable. When NIOZ started with Deep Sea Sampling we used a Shell double barrel traction winch driven by a DAF 33 car system. Engine + variomatic system. The first cable was a braided polypropylene cable. The disadvantage of this cable was the elongation of the cable during coring. It wasn't possible to take piston core samples with this cable. So in 1978 we decided to buy our first Aramide cable. The next sheets shows our cable history.

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

| | Cable 1, 1978 | Cable 2, 1982 | Cable 3, 1984 |
|---|---|---|---|
| Factory | Philadelphia Resins Corporation | Vermeire | Cable Belt L.t.d |
| Material | Phillystran –type ps 29 Kevlar | Kevlar 29 | Kevlar 29 |
| Construction | 19 x7 33d | C6-6AT4-Type 960 | 3 + 5 + 15 + 21 |
| Diameter | 8,4 mm with jacket 10,5 mm | 13 mm with jacket 15 mm | 10.5 mm with Hytrel jacket 14 mm |
| Total samples | 120 Deep Sea samples | 150 Deep Sea samples | 287 Deep Sea samples |
| Breaking strength by new cable | 5400 kg | 11250 kg | 9000 kg |
| Breaking strength after use | 3100 kg | 4000 kg | 5500 kg |

| | Cable 4, 1984 | Cable 5, 1986 | Cable 6, 1989 |
|---|---|---|---|
| Factory | Cable Belt L.t.d | Cable Belt L.t.d | Cousin Frères |
| Material | Kevlar 29 | Kevlar 29 | Cosa 17.3 mm |
| Construction | L.t.d3 + 5 + 15 + 21 | (3 + 3F + 10 + 10F) “S” + (16)Z” | Braided |
| Diameter | 10.5 mm with Hytrel jacket 14mm | 12 mm with Hytrel jacket 14,5mm | 15 mm with Hytrel jacket 17,3mm |
| Total samples | 350 Deep Sea samples | 75 Deep Sea samples | 1000 Deep Sea samples |
| Breaking strength by new cable | 12000 kg | 12000 kg | 20000 kg |
| Breaking strength after use | 4400 kg | 3400 kg | 9000 kg |

| | Cable 7, 1996 | Cable 8, 2010 |
|---|---|---|
| Factory | Cousin Trestec | Cousin Trestec |
| Material | Cosa 17.7 mm | Cosa 20 mm |
| Construction | Braided | Braided |
| Diameter | 15 mm with Hytrel jacket 17,3 mm | 15 mm with Hytrel jacket 17,3 mm |
| Total samples | Till now 1500 Deep Sea samples | |
| Breaking strength by new cable | 18000 kg | 21000 kg |
| Breaking strength after use | 14000 kg | |

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

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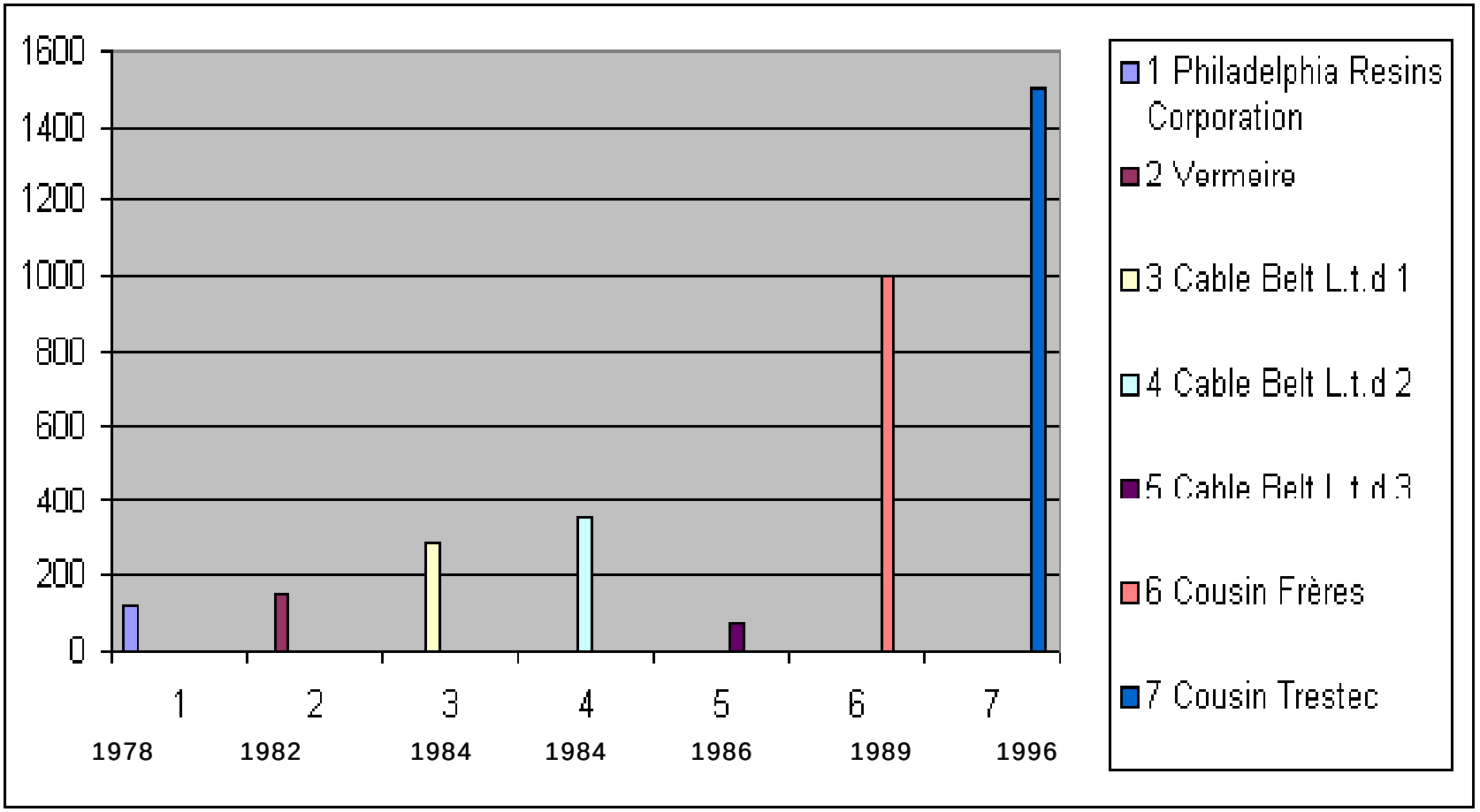


# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- In 1989 the first Cousin Frères cable.
- Breaking strength of 20.000 kg.
- The first year the breaking strength dropped to 12.000 kg.
- Stable from 1990 till 2001
- NIOZ had used the cable for box coring, multi coring, pisto coring, deep sea fishing and lowering bottom landers
- After 10 years the jacket of the cable was cracked almost completely.

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- In 2001 NIOZ got a new winch system
- Built by Kley France
- Double capstan winch with separate grooved rings on the barrels

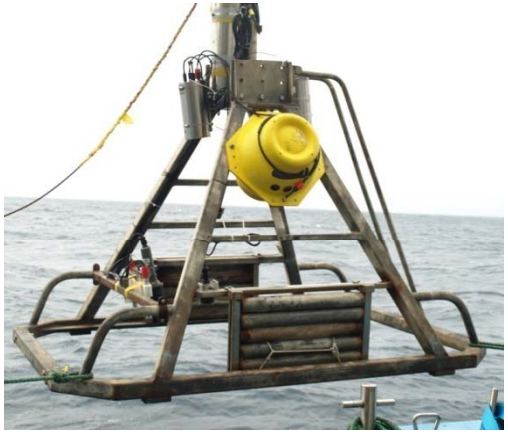
- The winch was a compromise because the Kley France Band winch would be to large
- The base is as large as a 20 feet container.

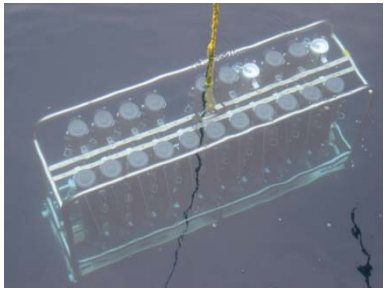
# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

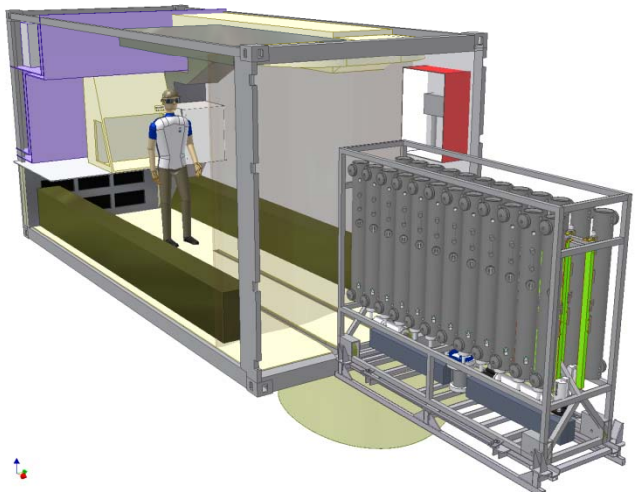
- Separate rings with a specific groove designed for the cable diameter.
- Both capstans barrels are made of stainless steel and have a smooth surface.
- Each barrel has 7 separate rings with a groove especially made for the diameter of the cable.
- The secret of this system is that each ring can set itself to the correct position which prevents the inner force into the cable.
- A standard double capstan winch will damage your cable as a result of the built up of the inner forces.

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- The second Cousin cable (7) was a combination of Super Aramide strands and a core of 7 copper conductors.
- The idea was to use the conductors for future applications. In the first few years we have used the cable only for coring and deep sea fishing.
- NIOZ had already an offline video system
- The next step was to use the copper conductors for online video.
- NIOZ use the cable now also for slow scan video and Super Clean CTD samples







# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

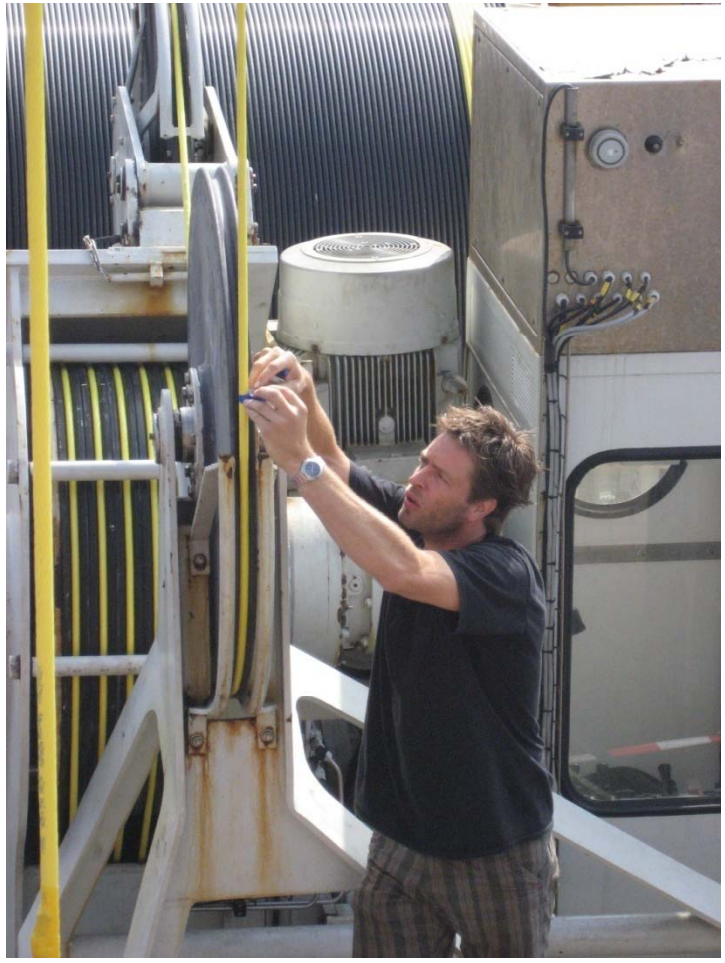
- The next step
- Fiber Optics in a Aramide cable.
- The first signals where not very positive.
- Cousin Trestec was not very interested to make such a cable.
- Meeting with Cousin Trestec, Nexan and NIOZ.
- The Nexan cable is a parallel construction cable.
- On a double capstan winch we prefer a braided construction
- We decided to do a test on our winch.

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- The Nexan cable trials.
- Nioz ordered a 300 mm piece of cable with the same diameter as the cable in use now.
- NIOZ build a test facility to mimic the way the cable is used at sea.
- Field test are not the same as factory test
- To do the test as optimal as possible we rent a 43 high mobile crane and used in combination with our deep sea winch.
- The intended number of hoisting/lowering cycles was 1000 with a weight of 2600 kg, the weight the company had advised.

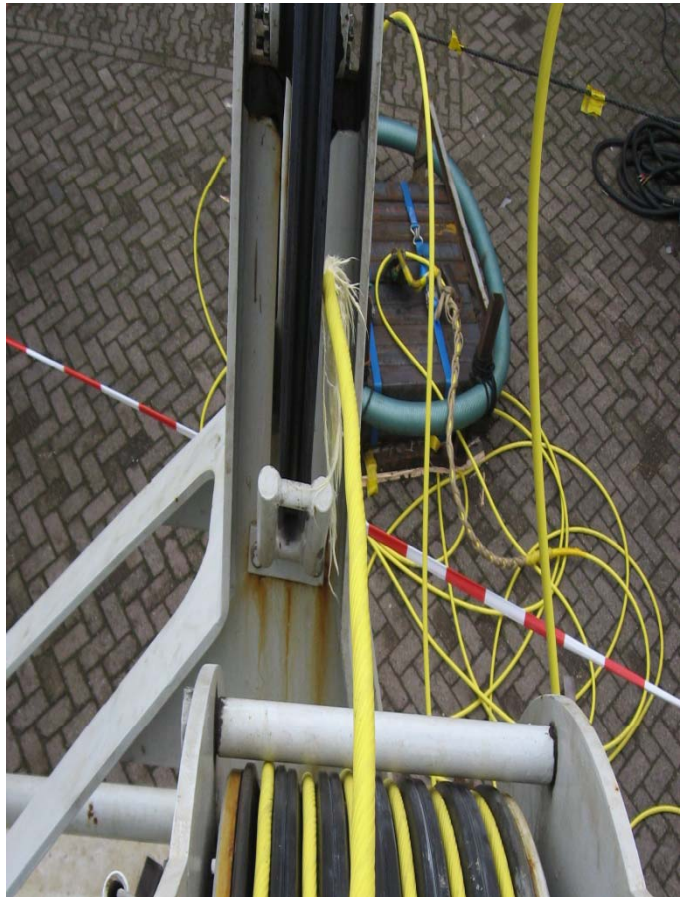
# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- The intended number of hoisting/lowering cycles was 1000.
- Those 1000 movements were representative of 10 year of deep sea sampling.
- We put several marks on the cable to know which part of the cable had passed which sheave.
- We expected that most damage would occur at the traction sheaves.
- And there is also one extra sheave on the winch where the cable bends in the opposite direction.
- This sheave is necessary to get the cable to the block which is in the side frame of the Pelagia.



# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- At run 526 a spontaneous cable break occurred.
- This was not what we expected. We were more afraid about the optical fibers than about the breaking strength of the Kevlar cable.
- But the optical fibers showed us that they gave no problems at all during the whole test. When the cable broke then the signal ended also.
- This means that the problems we expected during the test didn't come from the optical fibers but that the failure came from the Kevlar. The weight fell down from a height of 14 meters.



# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

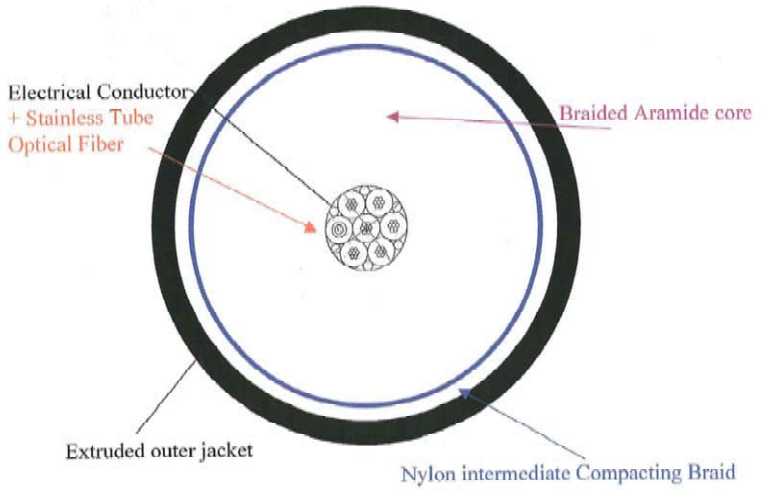
- Inspection of the cable:
- Optical tests, during tension tests and cycle tests by measuring
- Optical tests, during breaking tests by measuring.
- Optical inspection shows us that the inside abrasion of the Kevlar fibers destructed the cable by itself
- This trial showed us the NEXAN cable was not suitable for our type of work.

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- The next step was to go back to Cousin Trestec and talk again with them about a similar cable as the one we had before but with additional optical fibers inside.
- We had a discussion with Cousin about the cable and we came to the conclusion that we wanted to do the same test again.
- We now ordered a 300 meter piece of cable with a breaking strength of 20000 kg
- This meant we had to change the grooves to a 20 mm size.

COSA 20 MM

With Electrical Conductor + Optical fiber core

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# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- Again we wanted to go to 1000 runs.
- We set up a scheme for 24 hours a day.
- The weight was now 4000 kg, the maximum pulling force we may use with this cable.
- We made the 1000 runs easily.
- After the test we went to France for the final breaking test.
- The expectations were high
- But.. the result were not what we expected.
- Because the breaking strength had dropped to 8800 kg.

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- Super Aramide before test, breaking strength 20.000 kg

Super Aramide after test, 8800 kg

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

Super Aramide cable at the moment

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- At first we were not satisfied but after a while we came to the conclusion that we had completed what we wanted, 1000 runs.
- We had hoped for less dropping of the breaking strength.
- 4000 kg Pulling force we do not reach very often, only when the piston corer is stuck in the sediment.
- We decided to do one more test with 2000 kg on one sheave because we also did a breaking test on 1 sheave with a load of 4 tons.
- This test gave us enough confidence to continue with this cable
- We have now ordered this cable and we hope to do the first cruise with the Ultra Clean CTD system in April 2010.

Winch for 2000 kg test

# Cable trials Super Aramide in combination with optical glass fibers and copper conductors

- Conclusions
- Aramide cables have been the cable of choice for deep sea sampling.
- Aramide is still very expensive
- The life time has increased over the years NIOZ has used Aramide
- The advantage was easy coring (box, multi and piston coring)
- The advantage now is still easy coring + Ultra Clean CTD sampling + Video coring


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# Thank you