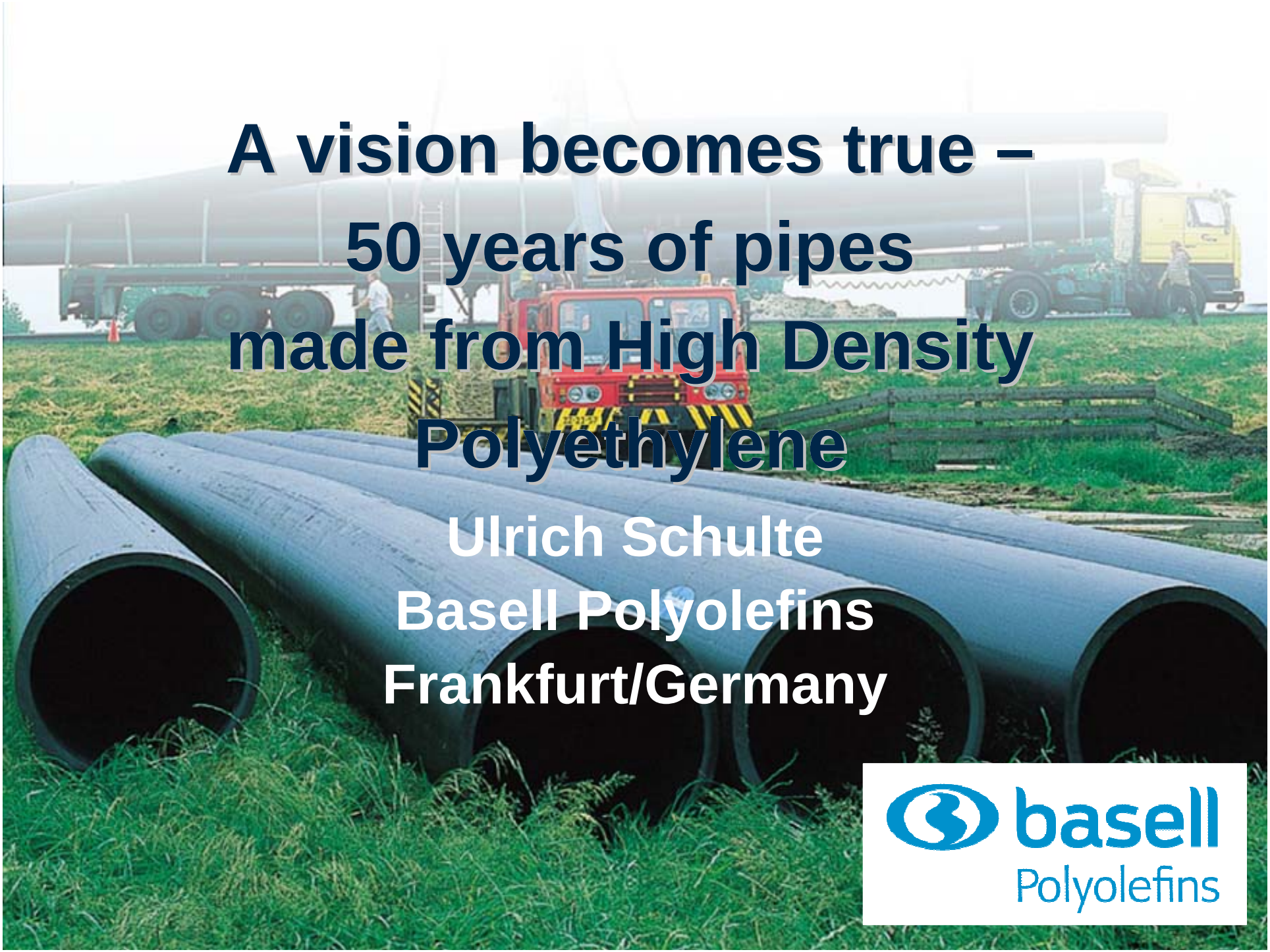
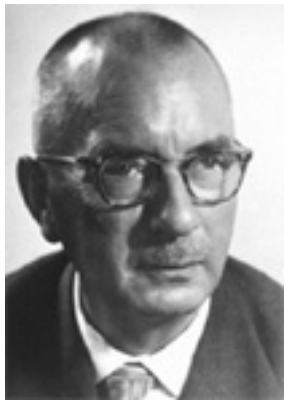


A vision becomes true – 50 years of pipes made from High Density Polyethylene

Ulrich Schulte
Basell Polyolefins
Frankfurt/Germany

basell Polyolefins

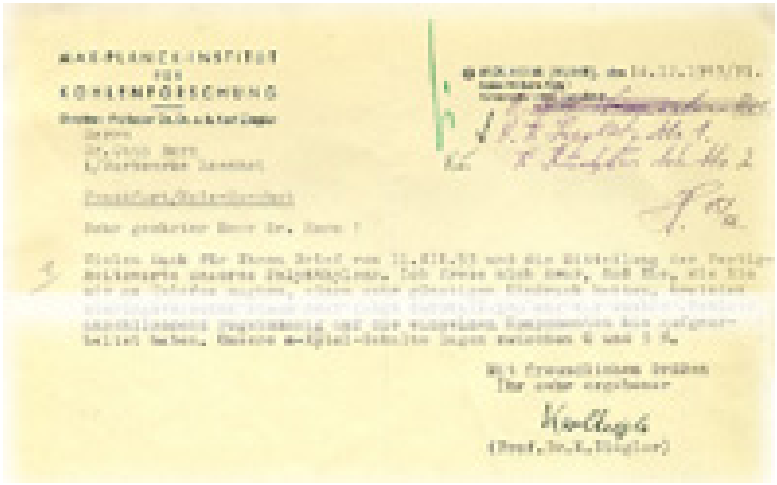
November 1953
Polymerisation of ethylene under mild conditions



In 1963 Karl Ziegler (left) received the Nobel Prize in Chemistry together with Giulio Natta for their discoveries in the field of the chemistry and technology of high polymers.

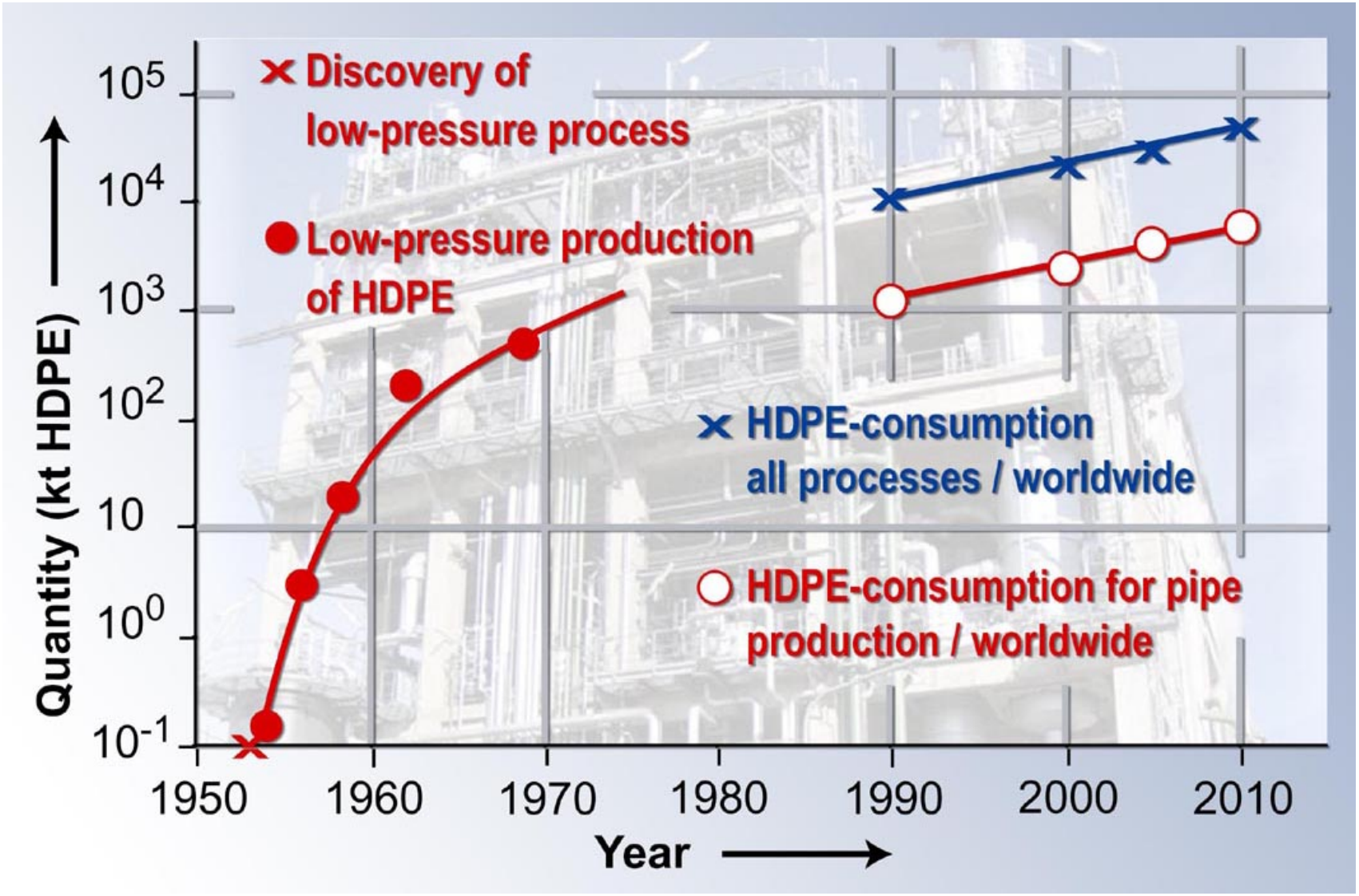
Fast and efficient:

Collaboration between
research institute and industry



December 1953: Karl Ziegler thanks Otto Horn, Head of Research at Hoechst, for having carried out tests with the new low-pressure polyethylene.

Development of HDPE production quantities
Meteoric in the first decade – above average right up to present day



Spring and Autumn 1955 – First presentations of pipes and fittings made from the new HDPE

Hanover Fair 1955

werk GmbH., Eschweiler, Krs. Aachen, sah man Lampenschirme aus Weich-PVC-Schaum.

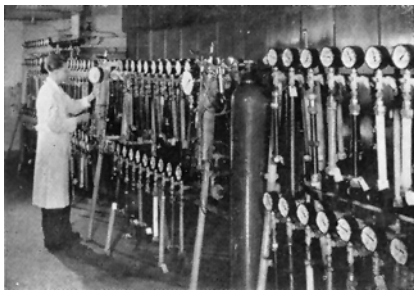
Auf dem Polyäthylen-Gebiet fand das von *Hoechst* erstmalig gezeigte Niederdruck-Polyäthylen nach *Ziegler* (Hostalen), das in Form von Folien, Schläuchen, Rohren, Formstücken, Wirbelsinter-Aufträgen usw. zu sehen war, besonderes Interesse. Der Schmelzbereich des Materials, das bei der Niederdruck-Polymerisation nach *Ziegler*[2]) pulverförmig anfällt, liegt bei 128 bis 135°, also wesentlich höher als der des normalen oder „Hochdruck"-Polyäthylens, dessen Polymerisation je nach dem gewünschten Polymerisationsgrad 600 bis 1500 at erfordert. Besonders hervorgehoben werden die hohe Reißfestigkeit und Dehnung sowie die große innere Zähigkeit bei guter Formbeständigkeit. Als Temperaturbereich der Verwendung

Hoechst presents the new low-pressure polyethylene at the Hanover Fair under the trade name *Hostalen*.

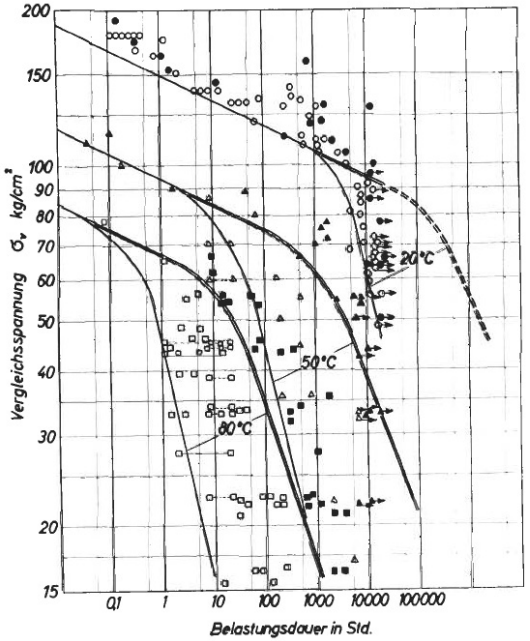
Plastics Fair in Düsseldorf 1955 (K 55)

At K 55 Ruhrchemie AG exhibited pipes in HDPE manufactured by the Ziegler process.

Creep rupture tests on pipes made from HDPE



The first creep rupture tests on pipes made from HDPE were already started in 1955



On 18th October 2006, two pipe specimens on this “historical“ test stand will finally confirm the predicted service of 50 years.

Dissertation by Dr. Erwin Gaube, 1959:

Given a permissible hoop stress of 50 kg/cm², the pipes will still have a 1.3-fold resistance to cracking after 50 years.

After 41 years' service: Residual life expectancy of 27 years

HDPE pipes installed in a shower and changing room in 1961 were dismantled and tested in 2002.

Property		Data sheet 1966	Pressure pipe - black 75 mm dia. SDR11		
			Inside	Middle	Outside
Density	g/cm³	0.955	–	0.9547	–
MFR 190/5	g/10 min	0.3	–	0.22	–
MFR 190/21.6	g/10 min	–	–	7.89	–
Reduced viscosity	dl/g	3.5	3.64	3.6	3.23
OIT at 200°C	min		2	25	28
DSC Tm_1	°C		130.28	130.01	129.98

Comparison of test results obtained on dismantled pipes with the original data sheet specifications for Hostalen GM 5010

The firm of Hessel-Ingenieurtechnik GmbH has calculated a residual life expectancy of at least 27 years – that corresponds to a total expected service life of at least 68 years.

Development of application technology: Extrusion of HDPE

End of the 1950s: pipe extrusion in the pilot plant at Hoechst

In the early years of production, raw material manufacturers were also involved in the further development of application technology for the new HDPE.

Machine manufacturers today supply high-performance extrusion lines for HDPE pipes.

Development of application technology: Pipe joining systems

Source: Hoechst

Developments in pipe production were accompanied by developments in hot plate butt fusion (on left: joining force applied manually, on right: modern fusion equipment for large bore pipes) and the use of electrical fusion sockets.

Source: Hoechst

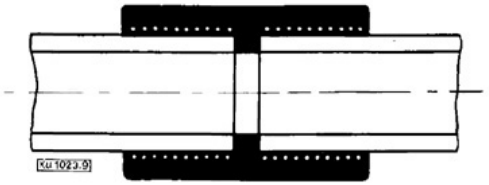


Abb. 9. Geschweißte Muffenverbindung mit elektrischer Heizwicklung der Süd-West-Chemie GmbH., Neu-Ulm

Source: Süd-West-Chemie

In use as early as 1956: Electrical fusion sockets for the joining of pipes

Processing of the new HDPE into pipes

From the middle of the 1950s, innovative companies either extended or changed their production programmes to include the extrusion of HDPE pipes – for example:

1956: Simona, Kirn, Germany
(from leather processing to plastic sheets, pipes and semi-finished products)

1957: Wiik & Hoglund (now KWH Pipe), Vaasa, Finland
(this company pioneered the production of large-diameter pipes)

1958: Gröter, Emsdetten (now egeplast, Greven), Germany
(from the processing of jute to the extrusion of HDPE pipes)

and a great many other companies both at home and abroad

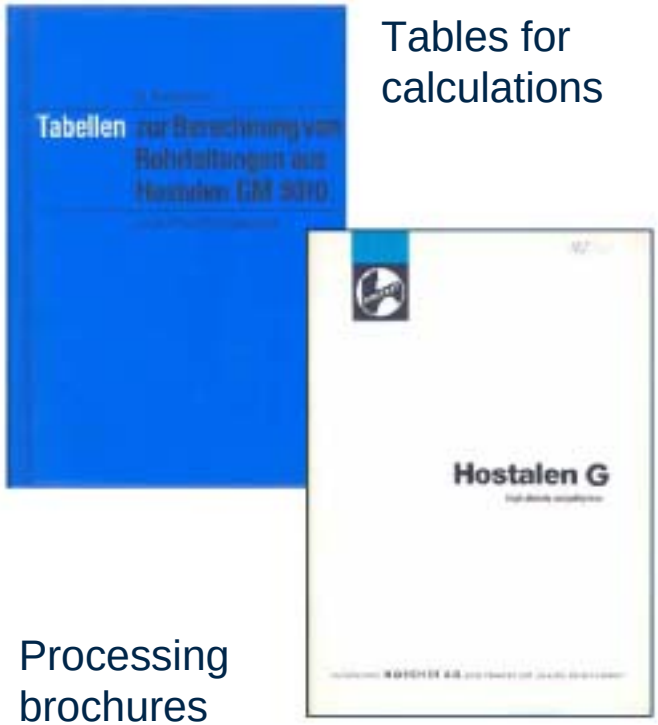
Early use of HDPE pipes:
Hula Hoop production

Informative printed matter on the new HDPE

Raw material manufacturers offer useful guides to processors and users:

Project reports

Application manuals

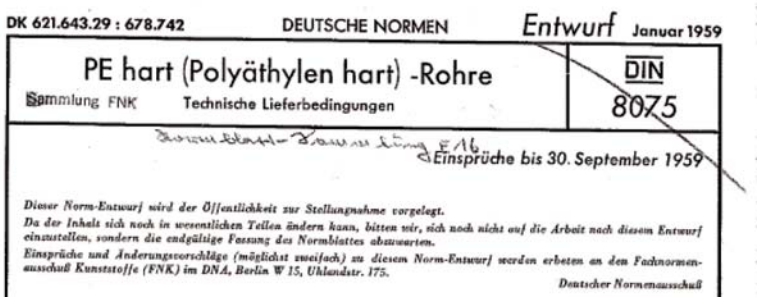


Tables for calculations

Processing brochures

A basis of trust: Standardisation and quality assurance

The standardisation of HDPE pipes began in 1957. The first draft of DIN 8075 was issued in 1959.



DK 621.643.29 : 678.742 DEUTSCHE NORMEN Entwurf Januar 1959

PE hart (Polyäthylen hart) -Rohre

Sammlung FNK Technische Lieferbedingungen

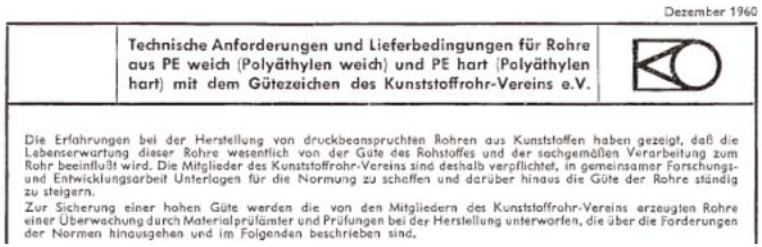
DIN 8075

Einsprüche bis 30. September 1959

Dieser Norm-Entwurf wird der Öffentlichkeit zur Stellungnahme vorgelegt.
Da der Inhalt sich noch in wesentlichen Teilen ändern kann, bitten wir, sich noch nicht auf die Arbeit nach diesem Entwurf einzustellen, sondern die endgültige Fassung des Normblattes abzuwarten.
Einsprüche und Änderungsvorschläge (möglichst zweifach) zu diesem Norm-Entwurf werden erbeten an den Fachnormenausschuß Kunststoffe (FNK) im DNA, Berlin W 15, Uhlandstr. 175.

Deutscher Normenausschuß

Quality assurance followed as early as 1960.



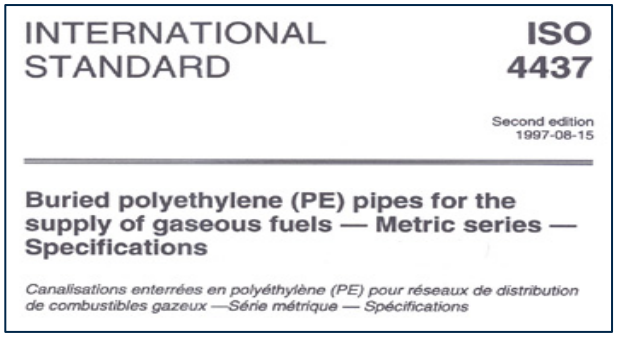
Dezember 1960

Technische Anforderungen und Lieferbedingungen für Rohre aus PE weich (Polyäthylen weich) und PE hart (Polyäthylen hart) mit dem Gütezeichen des Kunststoffrohr-Vereins e.V.

Die Erfahrungen bei der Herstellung von druckbeanspruchten Rohren aus Kunststoffen haben gezeigt, daß die Lebenserwartung dieser Rohre wesentlich von der Güte des Rohstoffes und der sachgemäßen Verarbeitung zum Rohr beeinflußt wird. Die Mitglieder des Kunststoffrohr-Vereins sind deshalb verpflichtet, in gemeinsamer Forschungs- und Entwicklungsarbeit Unterlagen für die Normung zu schaffen und darüber hinaus die Güte der Rohre ständig zu steigern.

Zur Sicherung einer hohen Güte werden die von den Mitgliedern des Kunststoffrohr-Vereins erzeugten Rohre einer Überwachung durch Materialprüfämter und Prüfungen bei der Herstellung unterworfen, die über die Forderungen der Normen hinausgehen und im Folgenden beschrieben sind.

And today the ISO standards and technical directives for water and gas pipes in HDPE are applicable worldwide.



INTERNATIONAL STANDARD

ISO 4437

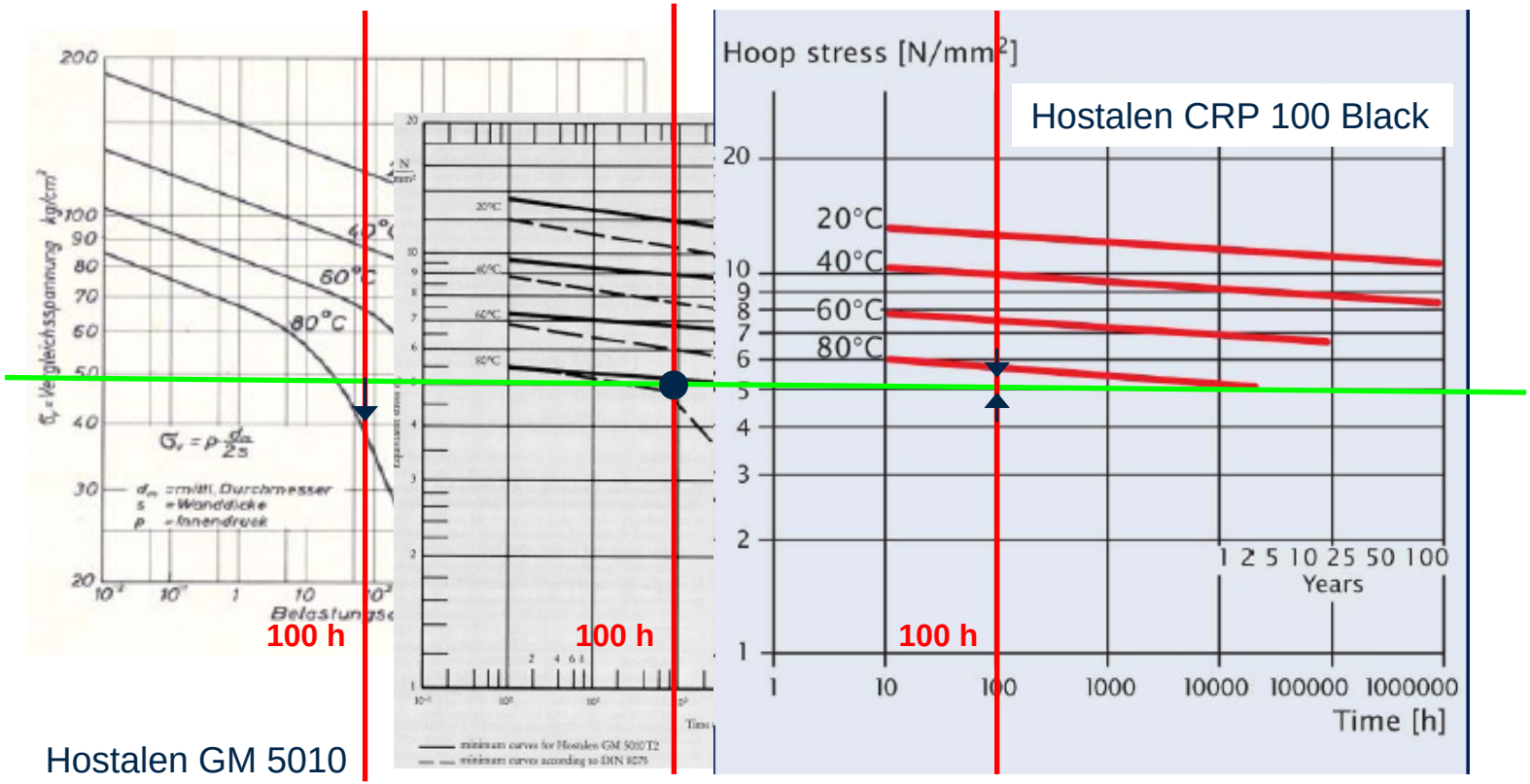
Second edition
1997-08-15

Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications

Canalisations enterrées en polyéthylène (PE) pour réseaux de distribution de combustibles gazeux — Série métrique — Spécifications

Further development of HDPE for pipe extrusion

The creep curves for HDPE pipe extrusion materials of the 1st, 2nd and 3rd generations testify to the technical progress made in this field



HDPE pipes: Service-proven in countless projects

Laying of pipelines for drinking water and gas (Island of Sylt, 2005)

PE 100 filament wound pipes for a culvert (pipeline under river, 2003)

Cooled underwater power cables being laid across lake bed (2005)

Laying of underground pipes for industrial sewage (Frankfurt 1963)

Unconventional method of transporting pipes to site

Water drainage pipes in open-cast lignite mine

The vision of the 1950s has today become a reality

- Following the discovery of the low-pressure process, the production of HDPE began at a pace that would be inconceivable today.
- From the very beginning, pipes manufactured from HDPE were able to meet high service life expectations.
- Today‘s HDPE pipe extrusion compounds of the 3rd generation are high-performance materials distinguished by their strength, stability and durability.
- Standardisation, quality assurance and the industry‘s own commitment (PE 100+ Association) give users the additional reassurance they need.
- The development of HDPE as a pipe extrusion compound has not yet reached its peak – the next generation is only just around the corner

Pipes made from HDPE are inexpensive,
environmental friendly and reliable,

In short:

i n d i s p e n s a b l e