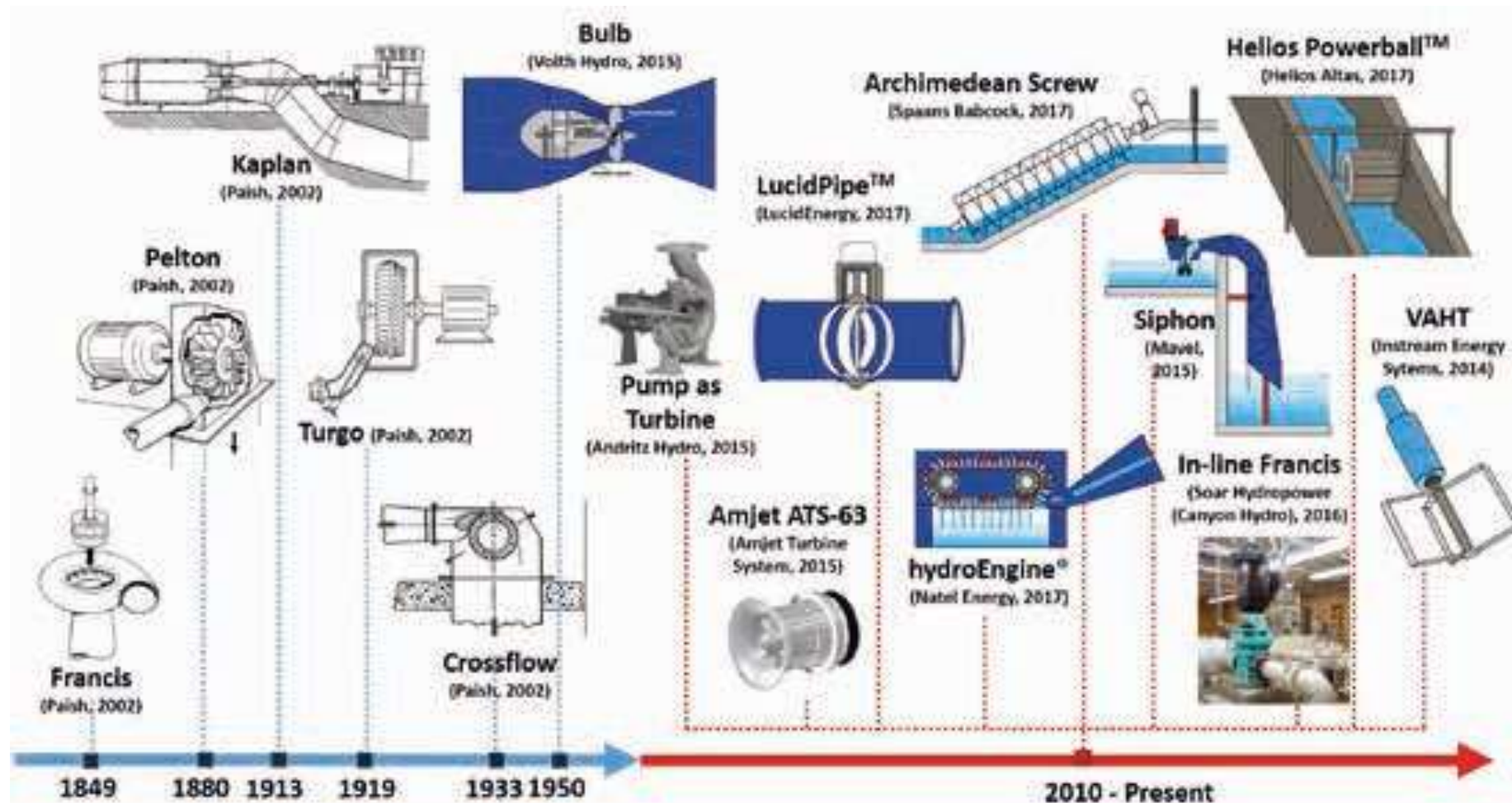


Energy recovery technologies in municipal water circuits



POWER GENERATION APPLIED TO CIRCULAR ECONOMY MODEL FOR HUMAN
WATER CONSUMPTION, POWER GENERATION, AND URBAN MOBILITY FROM
QMD PEOPLE

INTAKE

REPRESA SALVE FACHA
COTA: 3893 msnm

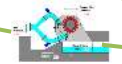


PCH QUILLUGSHA
COTA: 3807,5 msnm
POTENCIA: 547,88 kW



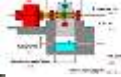
CAPTACION
RIO CHALPI
COTA: 3207 msnm

CENTRAL CHALPI
COTA: 2774,6 msnm
POTENCIA: 7,6 MW



CONVEYANCE

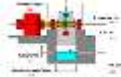
PCH AMPLIACION
RECUPERADORA
POTENCIA: 14 MW



CENTRAL RECUPERADORA
COTA: 3110 msnm
POTENCIA: 14,76 MW



PCH PLANTA BELLAVISTA
COTA: 2978 msnm
POTENCIA: 330 kW



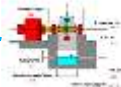
TREATMENT

PLANTA TRATAMIENTO AGUA
3 m3 / s



DISTRIBUTION

INGRESO TANQUES DISTRIBUCION
(Agua Tratada)



PCH TANQUE BELLAVISTA
COTA: 2904 msnm
POTENCIA: 213 kW

PCH TANQUE CARCELEN
COTA: 2790 msnm
POTENCIA: 330 kW



WATER FOR HUMAN CONSUMPTION, POWER GEN.
AND URBAN MOBILITY

INTAKE
DARK WATER

PROYECTO DESCONTAMINACION DE LOS RIOS DE QUITO
COLECTOR DE AGUA SERVIDA IÑAQUITO

PCH BATAN 1 Y 2
COTA: 2545 msnm
POTENCIA: 6 MW



CONVEYANCE



PCH NAYON
COTA: 2368 msnm
POTENCIA: 7 MW

SERVED WATER TREATMENT

PTAR VINDOBONA



CENTRAL VINDOBONA
COTA: 2332 msnm
POTENCIA: 30 MW



WATER FOR IRRIGATIONS, POWER GEN.
AND URBAN MOBILITY

CUERPO RECEPTOR
Río Guayllabamba



EPMAPS
AGUA DE QUITO



Antonio Villagómez:
Know-how for Small Power
Hydro (SPH) development.
Public sector company
experience. EPMAPS case

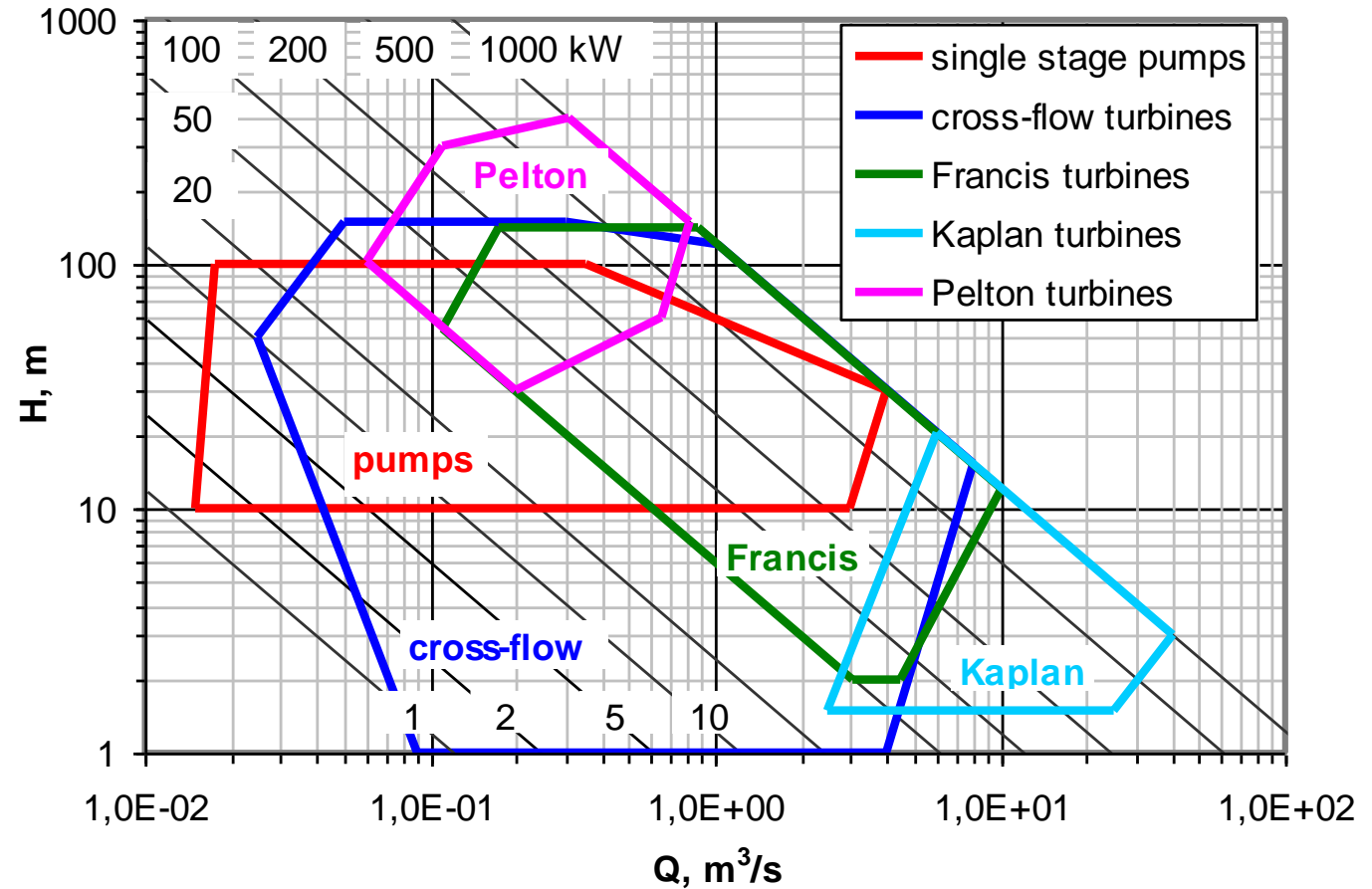
Hydropower Solutions
HYPOSO

Workshop on Small Hydropower
Framework Conditions in Ecuador
Quito, 26 July 2022

EXAMPLES

● Operating ● Under const. ● Final Design Projects

Pumps as turbines -typical operation ranges



Source: Engeda A., Strate P., Rautenberg M.: *Auswahl von Kreiselpumpen als Turbinen*. Pumpentagung Karlsruhe'88, Sektion A6, Fachgemeinschaft Pumpen im VDMA, Frankfurt/Main, Oktober 1988

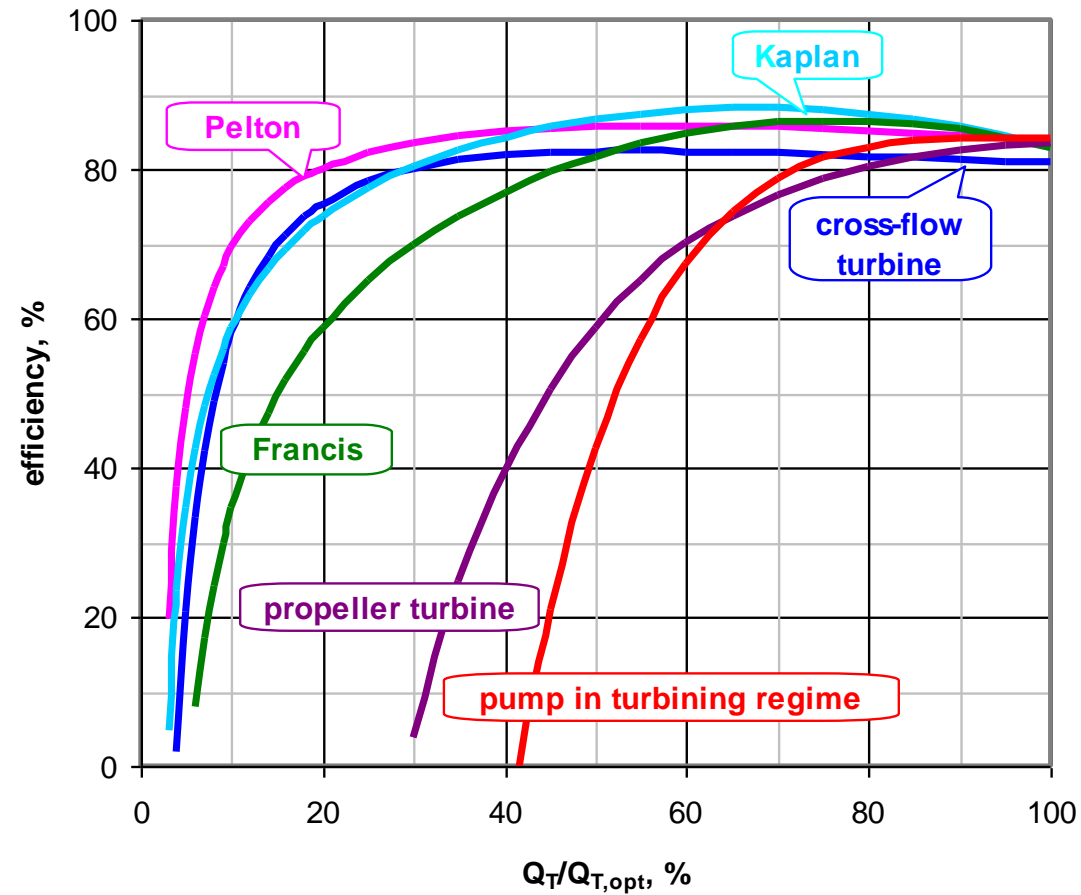
Pumps in turbine mode of operation may be applied for heads between 2 and almost 1000 m, with capacities up to almost 2 MW

Pumps as turbines -typical efficiency characteristics

Source:

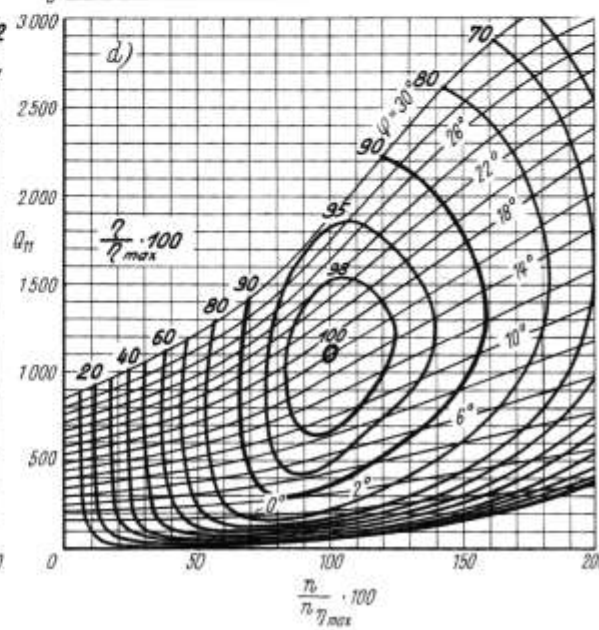
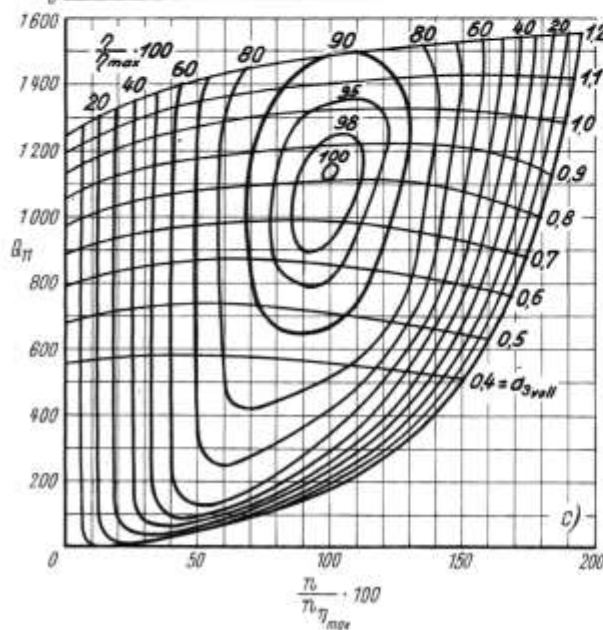
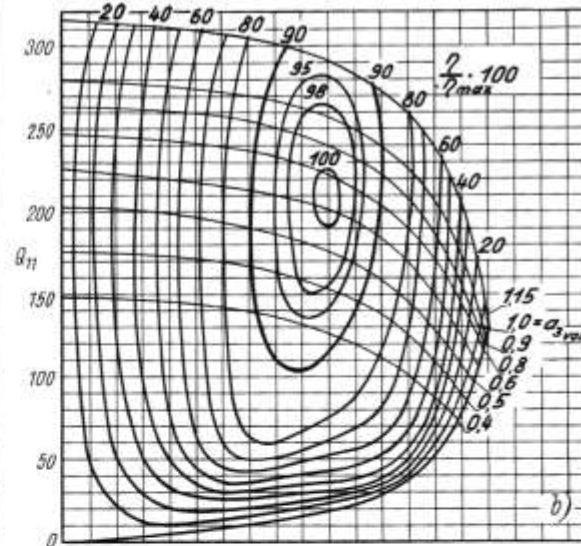
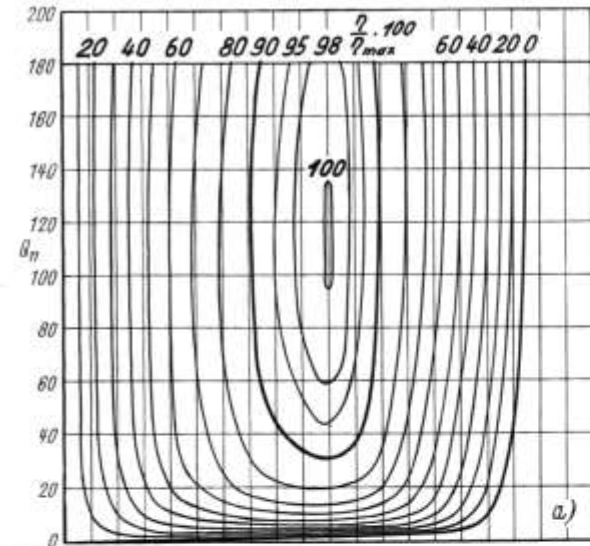
Engeda A., Strate P.,
Rautenberg M.: *Auswahl von
Kreiselpumpen als Turbinen*.
Pumpentagung Karlsruhe'88,
Sektion A6, Fachgemeinschaft
Pumpen im VDMA,
Frankfurt/Main, Oktober 1988

Surek D.: *Parameter und
Leistungen rückwärtslaufender
Kreiselpumpen mit
Frequenzumrichter*,
Pumpentagung Karlsruhe'92,
Fachgemeinschaft Pumpen
im VDMA, Frankfurt/Main,
Oktober 1992, Beitrag A5-01



Can speed regulation be a remedy to the steep efficiency characteristics?

Hydraulic turbine efficiency hills



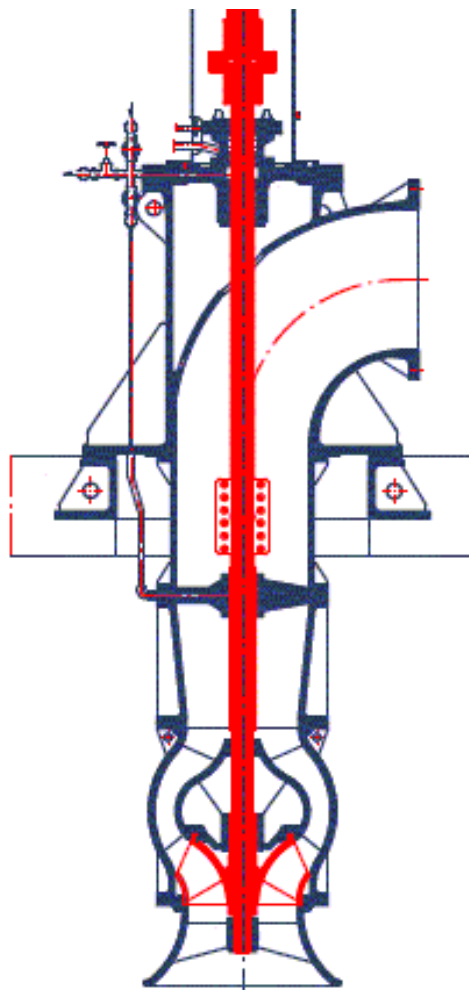
Can speed regulation be a remedy to the steep efficiency characteristics of a unit without mechanical flow regulation?

Only in some cases!

- a) Pelton turbine
- b) Francis turbine (low specific speed)
- c) Francis turbine (high specific speed)
- d) Kaplan turbine

Source:

Raabe, J. (1989): Hydraulische Maschinen und Anlagen, 2.Auflage, VDI Verlag, Düsseldorf



Pump manufacturer:

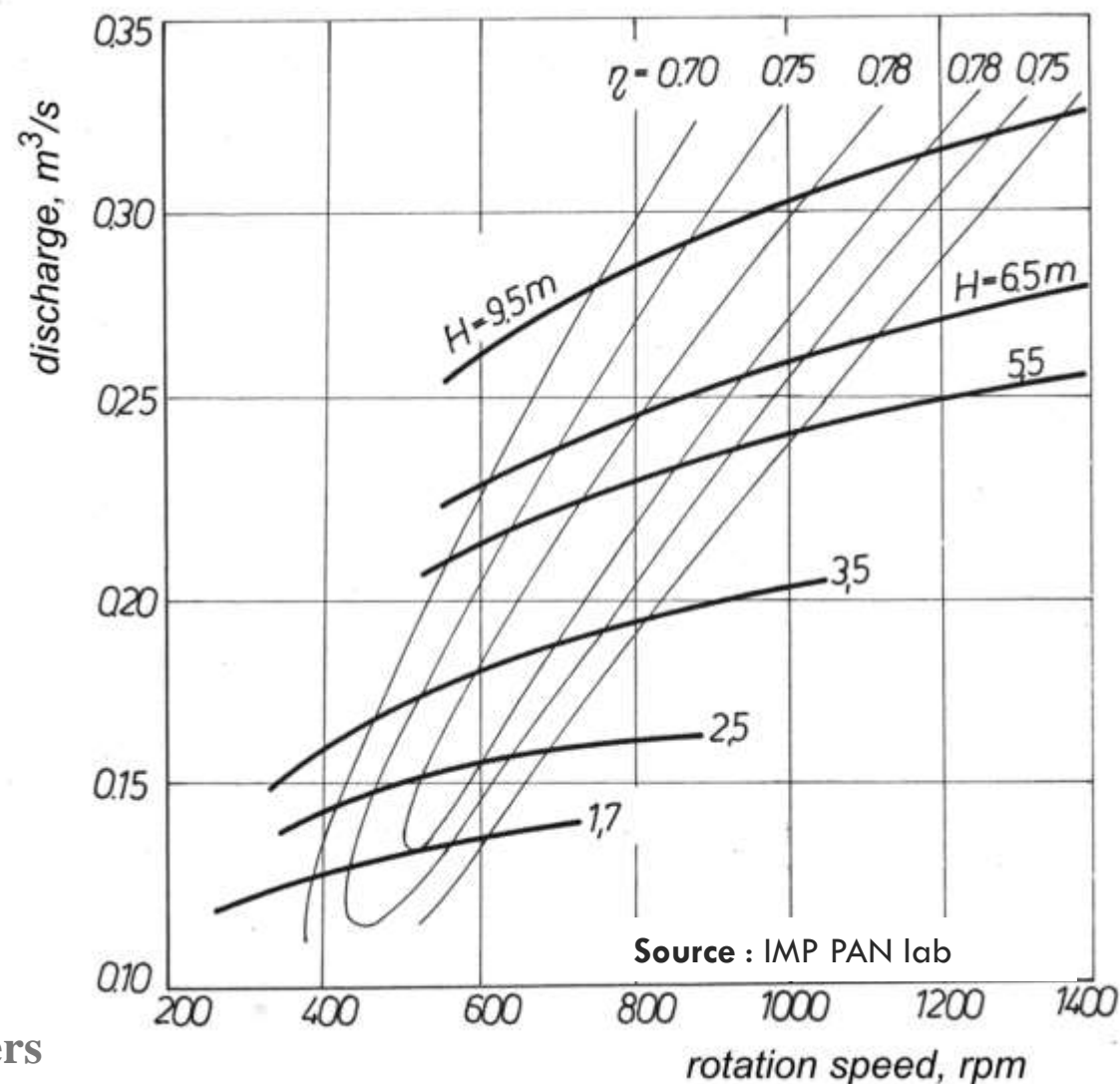
POWEN-WAFAPOMP SA

previously:

Warsaw Pump Manufacturers

35D40 MIXED-FLOW PUMP

- EFFICIENCY HILL IN THE TURBINE MODE OF OPERATION



150PJM CENTRIFUGAL PUMP

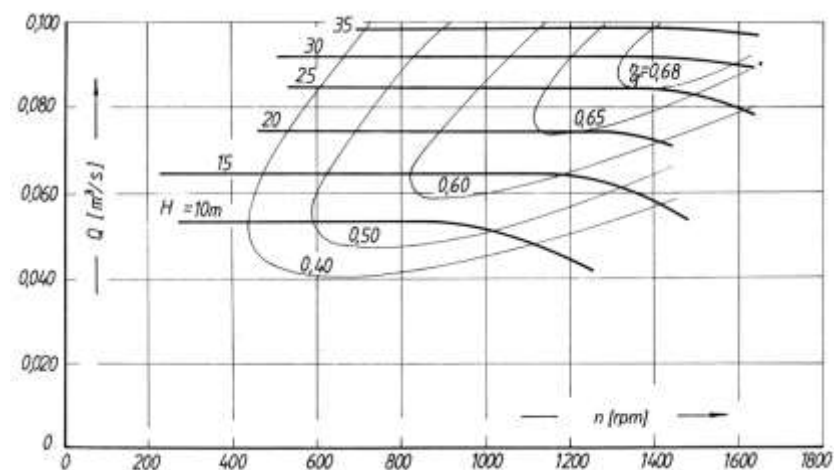
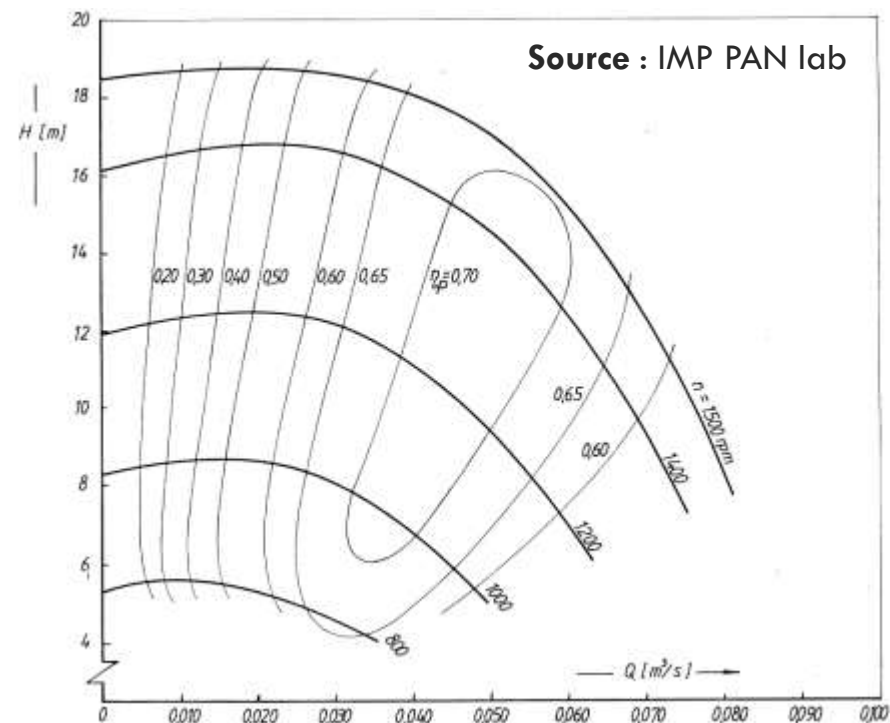
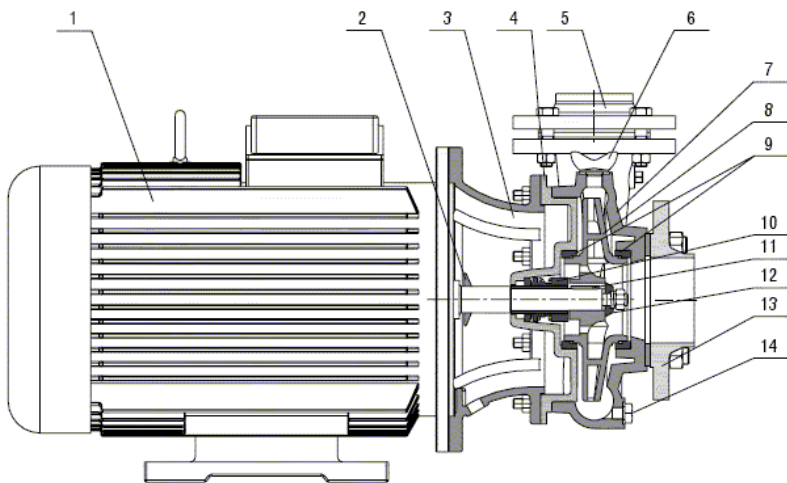
- EFFICIENCY HILL DIAGRAMS



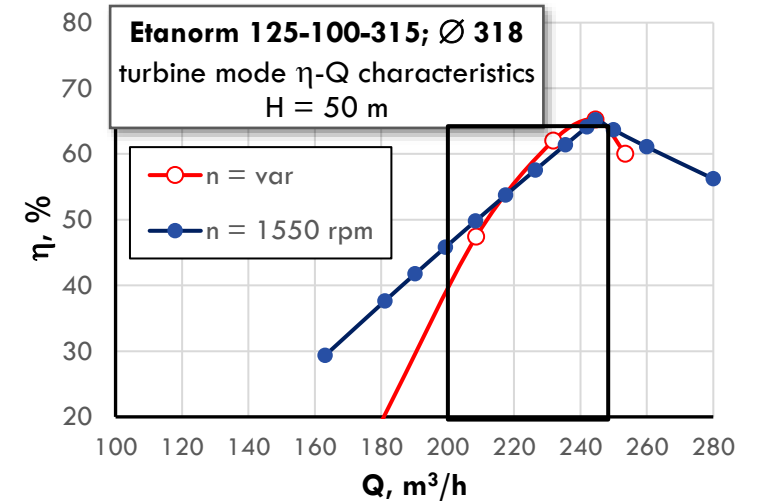
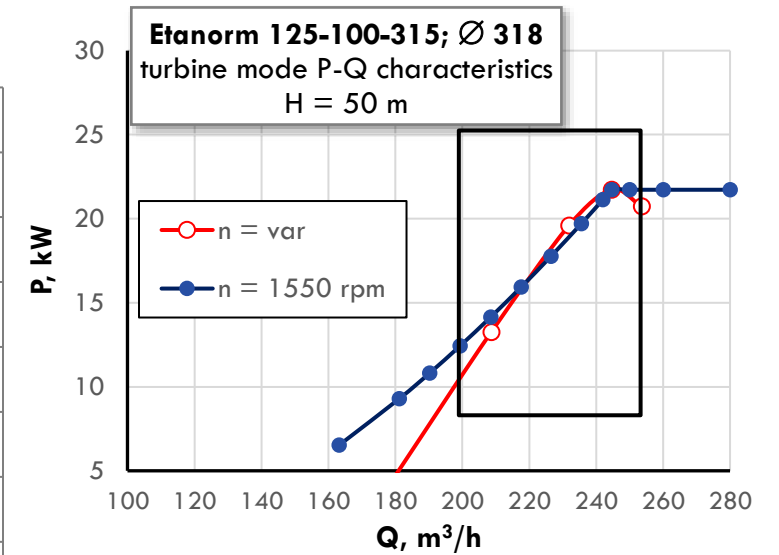
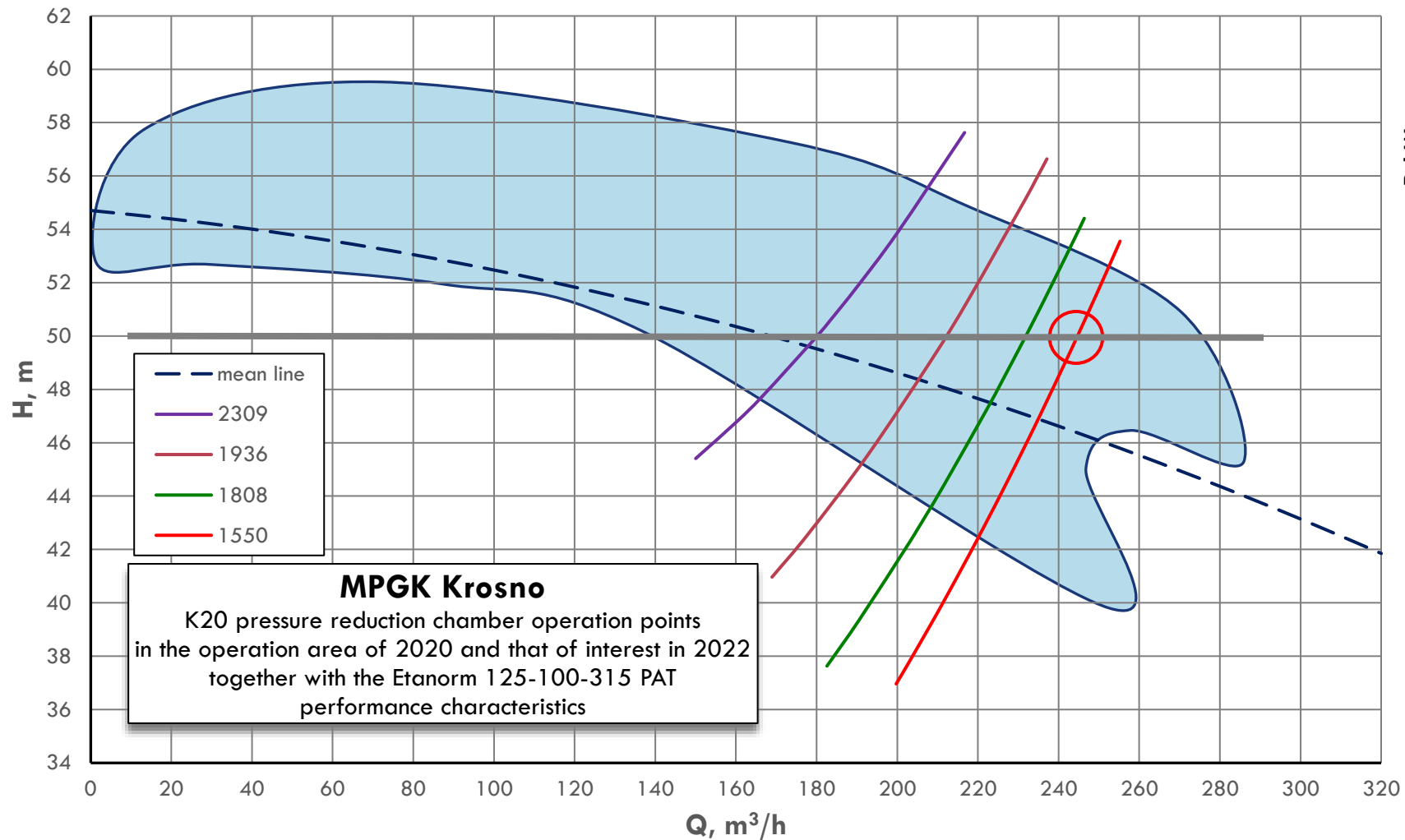
Straszyn 1994

Pump manufacturer:

Leszno Pump Factory



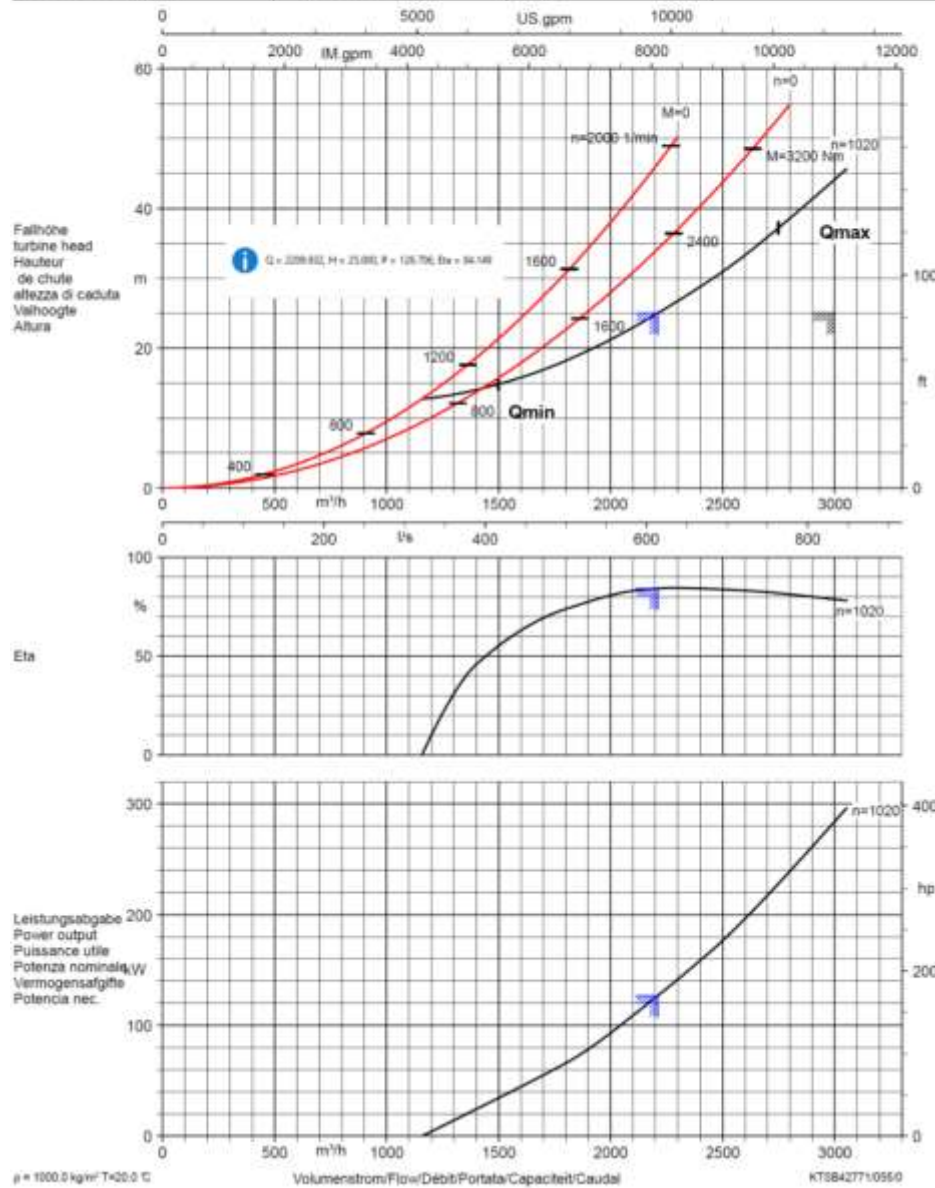
PAT performance curves



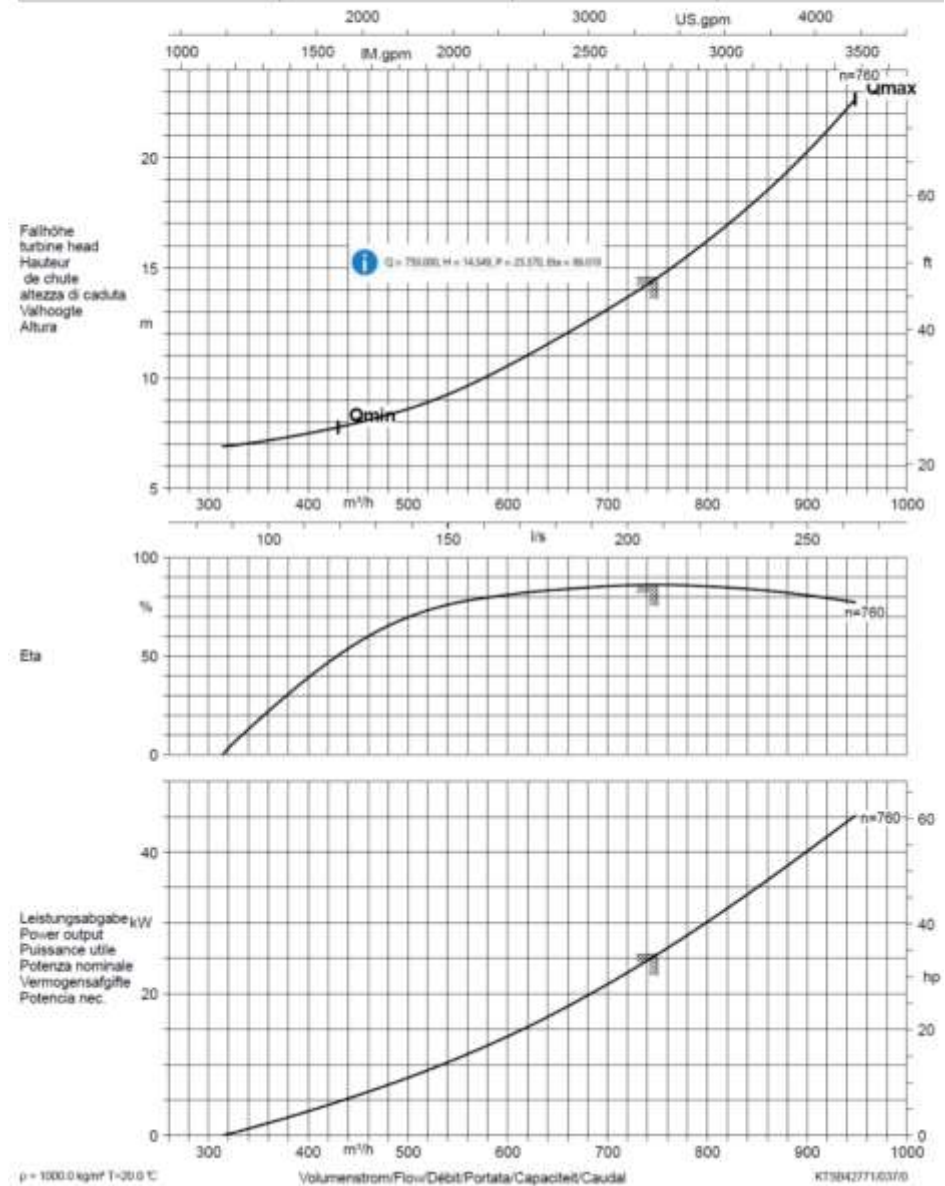
PAT performance curves



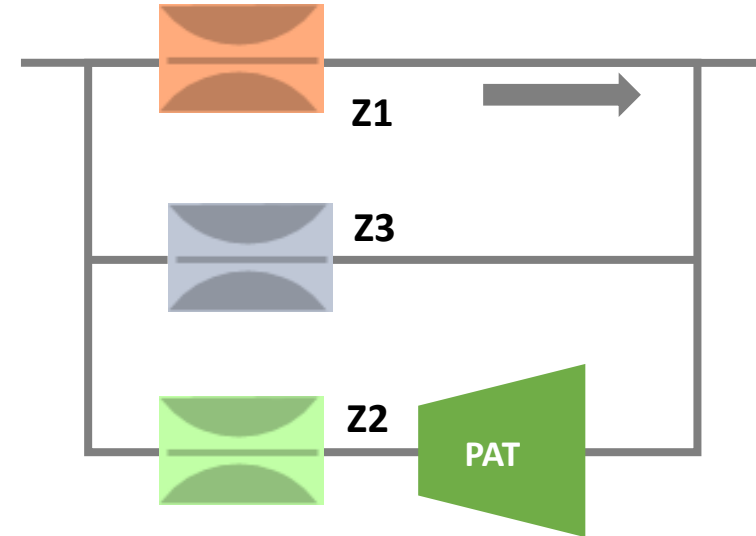
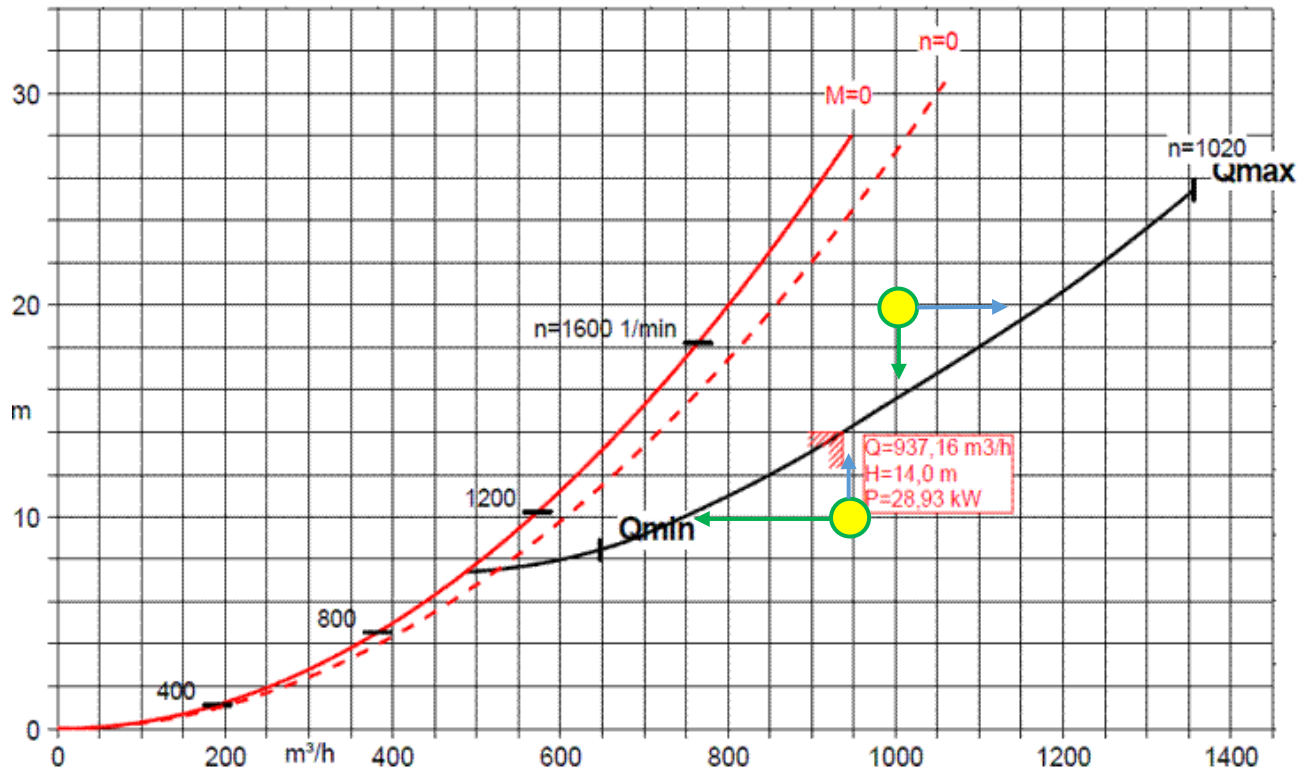
Baureihe-Größe Type-Size Modello	Typ Serie Tipo	Nenn Drehzahl Nom. speed Velocità nom.	Velocità di rotazione nom. Nominal rotational Revoluciones nom.	Laufschalld. Impeller diameter Diamètre de roue	Ø Garantie Ø Stator Ø Rueda
Omega 350-430A Turbine		1020 1/min		440 mm	
Projekt Project Projet	Progetto Projecto	Angebot-Nr. Project No. No. de l'offre	Offerta-Nr. Offertario Oferta-Nr.	Pos.-Nr. Item No. No. de pos.	Pos.-Nr. Positem: Pos.-Nr.
PaT 3000 m3/hr		4003485840		100	



Baureihe-Größe Type-Size Modello	Typ Serie Tipo	Nenn Drehzahl Nom. speed Velocità nom.	Velocità di rotazione nom. Nominal rotational Revoluciones nom.	Laufschalld. Impeller diameter Diamètre de roue	Ø Garantie Ø Stator Ø Rueda
Omega 250-370A Turbine		760 1/min		390 mm	
Projekt Project Projet	Progetto Projecto	Angebot-Nr. Project No. No. de l'offre	Offerta-Nr. Offertario Oferta-Nr.	Pos.-Nr. Item No. No. de pos.	Pos.-Nr. Positem: Pos.-Nr.
PaT Porma León		4003581748		100	



PAT based energy recovery systems



Z1 valve closed when Z2 throttles

Z1 valve opens when Z2 closed
or outlet pressure too small with Z2 fully open

Z2 valve closed when discharge or head too small!

Z3 valve opens in emergency (pressure surge at inlet)

Adjusting PAT operation point

to that following from the required/recorded pressure reduction node operation parameters.

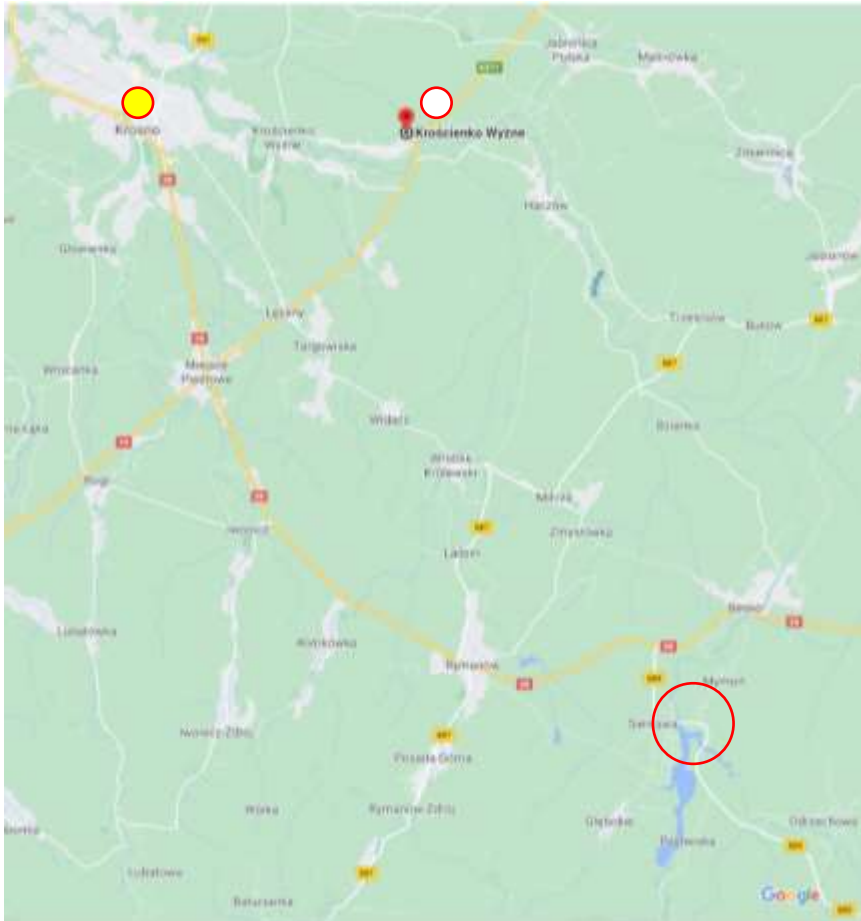
Taking due account of hydraulic losses necessary during control and simulations!

PAT based energy recovery systems

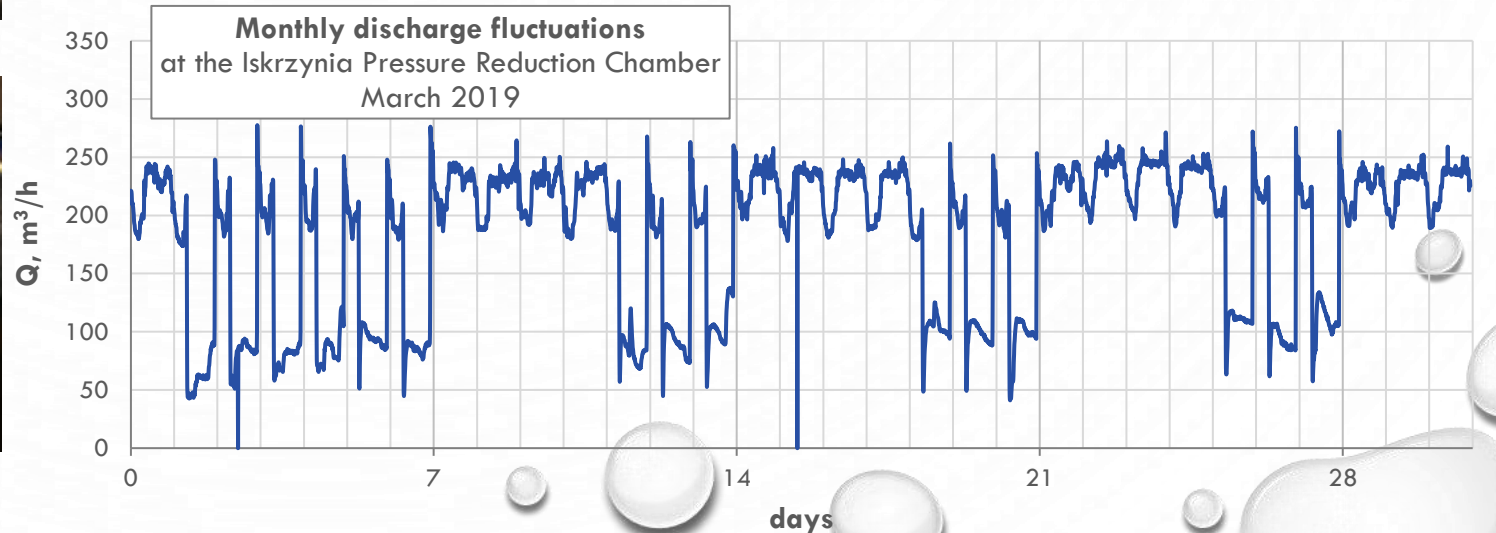
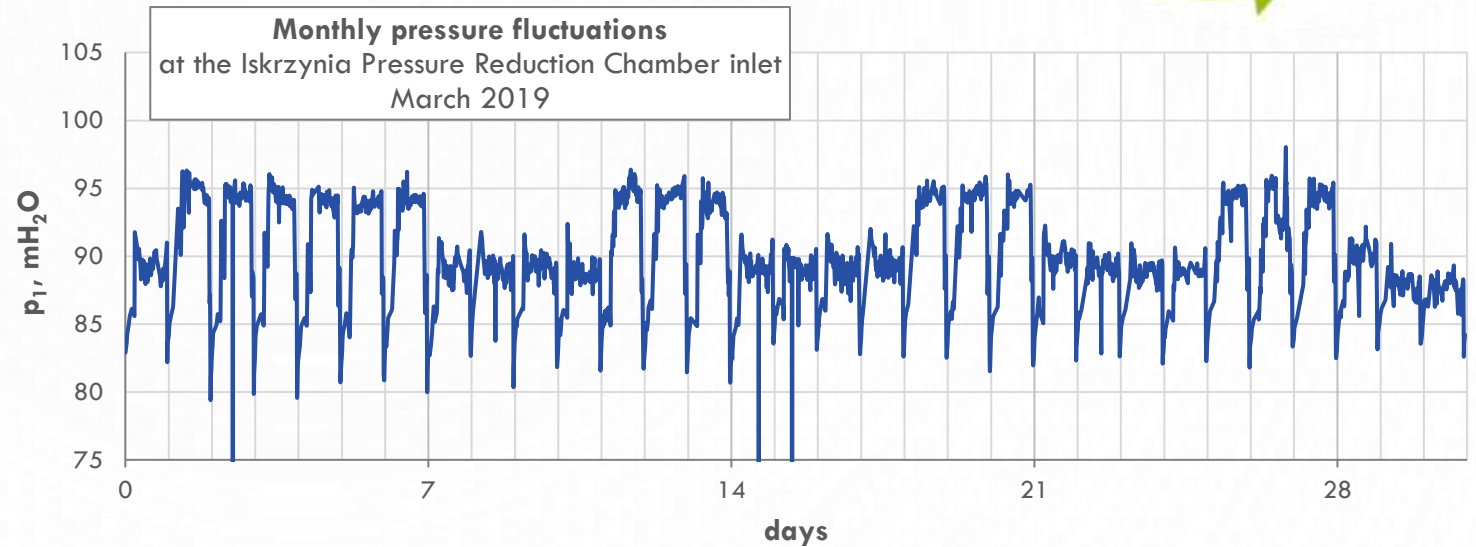


15. Krosno Municipal Co.: PRV / Urban

Location: Iskrzynia DWTP



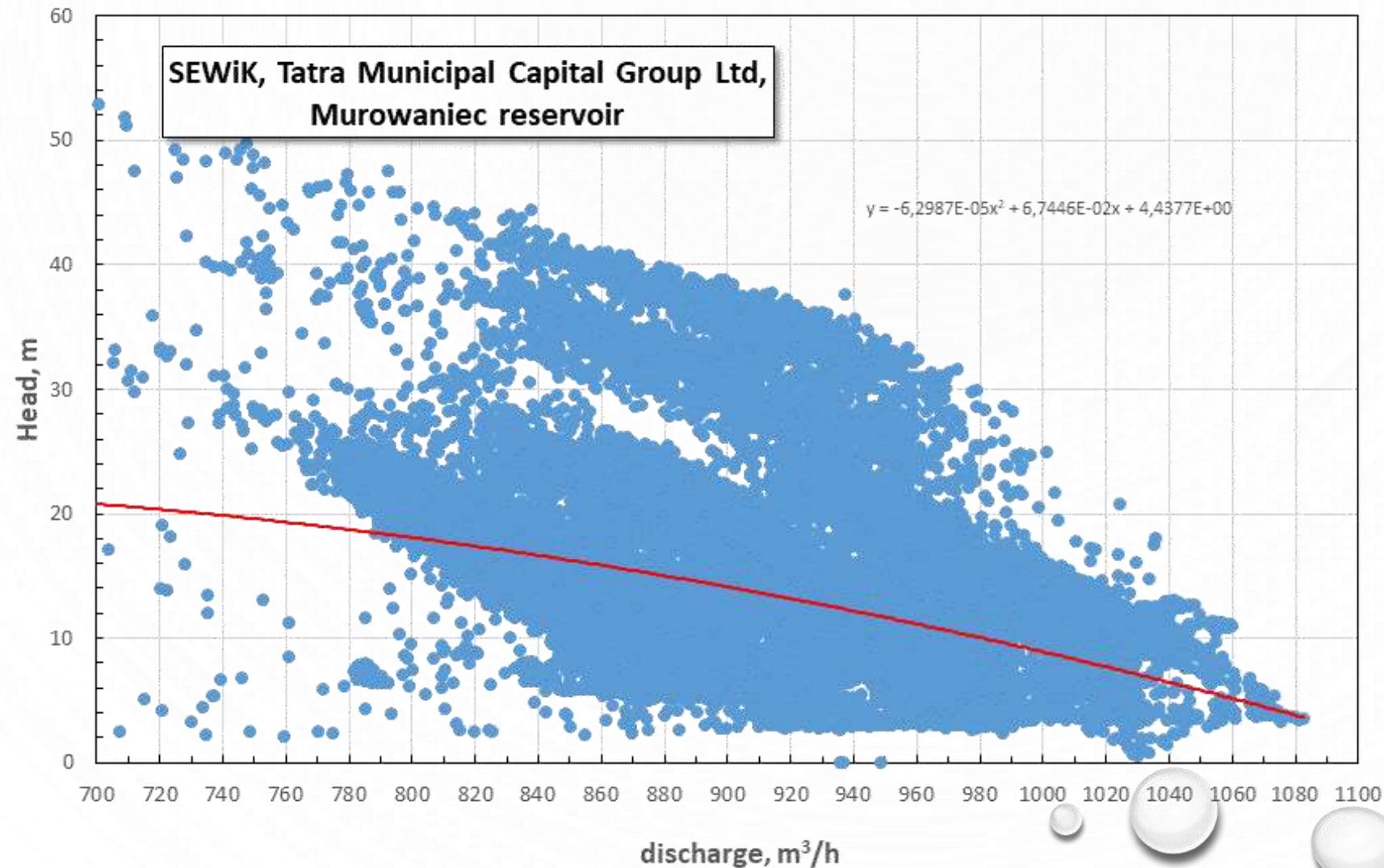
MPGK Krosno: Komora redukcji ciśnienia przy Stacji Uzdatniania Wody Iskrzynia



Murowaniec Reservoir SEWIK Zakopane



Murowaniec Reservoir SEWIK Zakopane



Murowaniec Reservoir SEWIK Zakopane

