Extrusion Screw Design: A Historical Perspective

Screw design has evolved over the years, but some historical perspective can lead to innovative new designs for the future. In this four-part series, we’ll explore the history of extrusion screw designs.

By R.F. Dray and R.B. Gregory

Editor’s Note: Sometimes a little history is important to influence future innovations. Robert Dray, founder of R. Dray Manufacturing Inc., and Robert Gregory, owner of consulting firm Robert Gregory and Associates, offer up their in-depth history of the origins and development of the extrusion screw.

This historical representation is generated from … actual patents. In technology advances that were not patented, the information shown was given by people who were directly involved at that time.

1928 – 1932
These designs (basic) were originally for extruding rubber. They consisted of a constant depth root with flights of variable lead. Many designs of this type are still used for extruding rubber. It should be noted that these designs were melt fed.
All art courtesy of Robert F. Dray

1945 – 1950
The Torpedo design (basic) and longer l/d attempted to improve pellet melting by the torpedo addition to the variable lead constant root rubber designs. The Dulmage Mixing design (basic) also initially utilized the variable lead constant root rubber design but added distributive mixing. This is a good design, and the original or new versions are occasionally used today.
1950 – 1955

The Square Pitch Constant Lead design (Basic) was the first design to depart from the prior rubber designs. Longer I/d and the shallowing root enabled higher processing rates. Vented Extrusion (basic) was developed by A. Kaufman (founder of Prodex). He presented this concept to the Palisades SPE section and was virtually laughed at. He never patented the idea as he did not believe patents were worthwhile. Square Pitch Two Stage Design (Improvement) improved mixing and lowered melt temperatures for selected resins.

1955 – 1960

Pin Design (basic) improved distributive mixing. Ring Valve Design (Basic) was a design ahead of its time. When the screw was stopped, it could be moved forward or rearward to increase or decrease the ring valve to barrel clearance. This increased or decreased the shear rate through this orifice. This also increased or decreased the upstream pressure that could influence not only melt quality and temperature but the overall rate.

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ABOUT THE AUTHORS

Robert B. Gregory started at NRM in 1958. He began in the engineering department and was manager of development engineering when he left in 1964. He joined Egan Machinery in 1964 and worked with Bill Willert and Lou Street as assistant director of research and development until 1971. He left to start his own consulting company, Robert Gregory and Associates.

Robert F. Dray started at NRM in 1960, starting out in the engineering department. He left as manager of feed screw production in 1966. He founded Feed Screws Inc. (now Nordson Xaloy) in 1966. Feed Screws was the first U.S. non-OEM company to manufacture extrusion screws. He then founded — and still operates — R. Dray Manufacturing Inc. He also founded U.S. Valves in 1991 and sold that company in 1993. He founded Integrated Molding in 1994, selling that company in 1996.