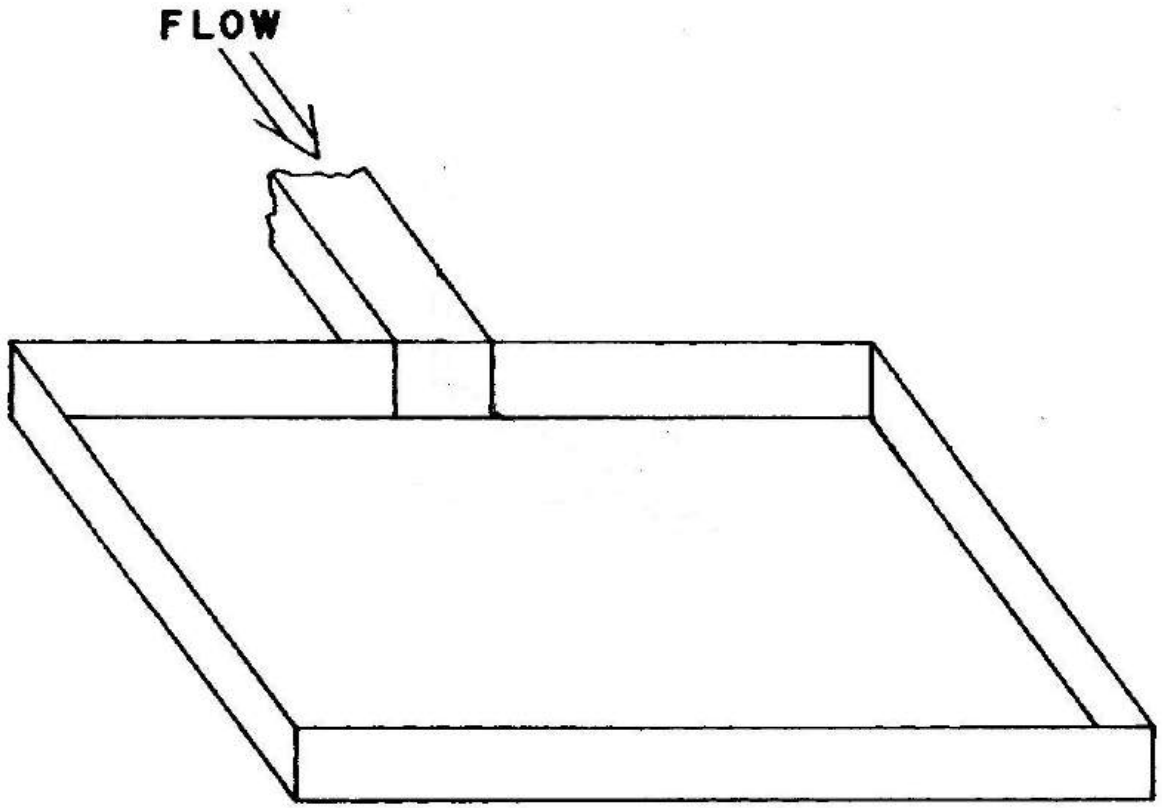
FOUNTAIN FLOW IN INJECTION MOLD FILING

- The phenomenon has been first described by W. Rose, Nature, **191**, 242-243 (1961), when a plunger pushes a fluid into a channel of same cross section. The fluid moves faster at the center and spills out to the channel wall, like……. a fountain.
- Described in several textbooks on polymer processing
- Experiments were carried out by L.R. Schmidt (1974), at GE, Schenectady, NY
- Computer simulations were carried out by H Mavridis, AN Hrymak, J Vlachopoulos (1986-1988), at McMaster University, Hamilton, ON, Canada

SCHMIDT's experiments at GE (USA), Pol. Eng. Sci, **14, 797-800 (1974)**

"A special mold and tracer technique for studying shear and extensional flows in a mold cavity during injection molding"

The polymer is pushed by the plunger of a capillary viscometer into a rectangular mold cavity

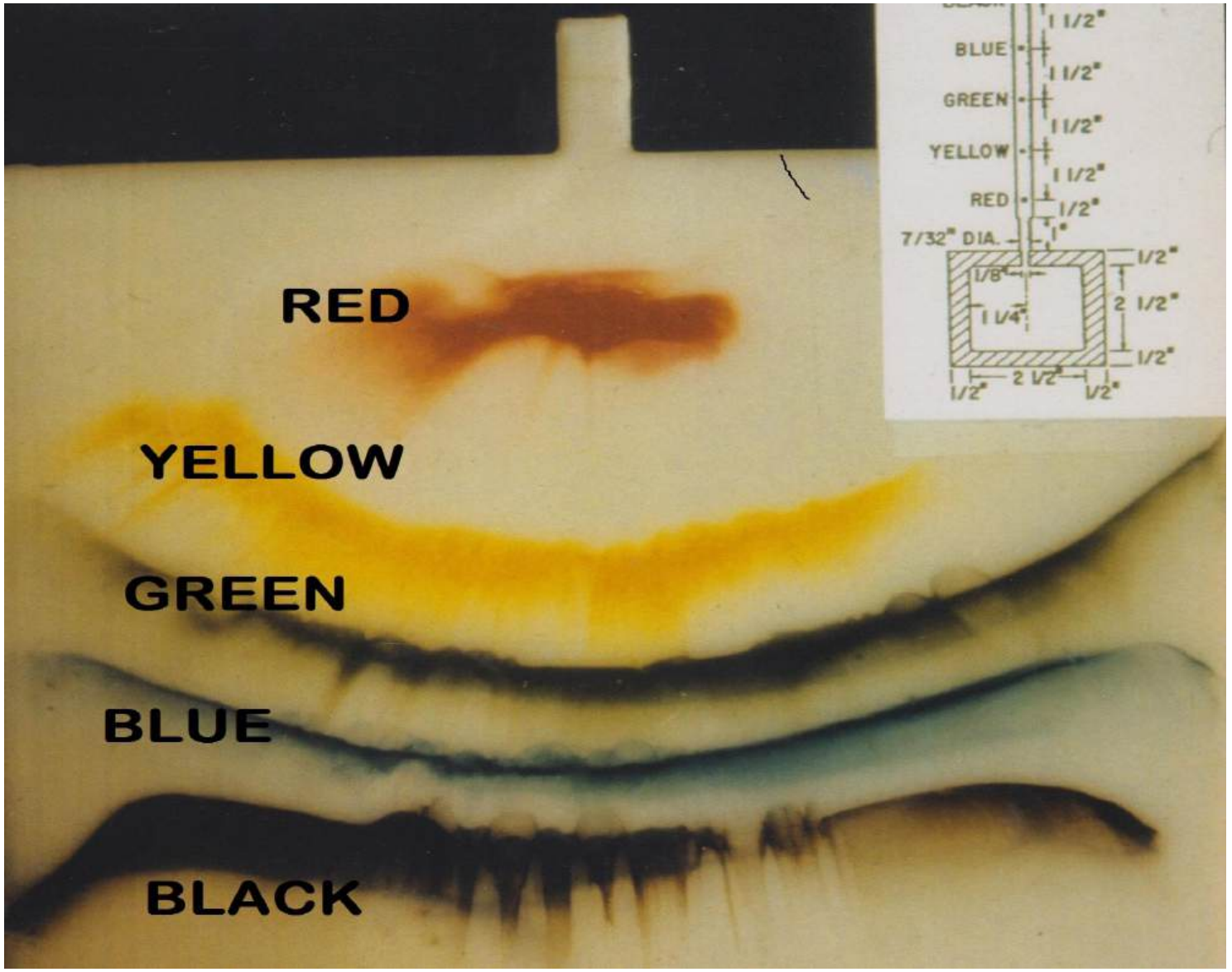


Schmidt had inserted color tracers in the rod before heating and melting and then pushed the molten rod into the rectangular mold cavity

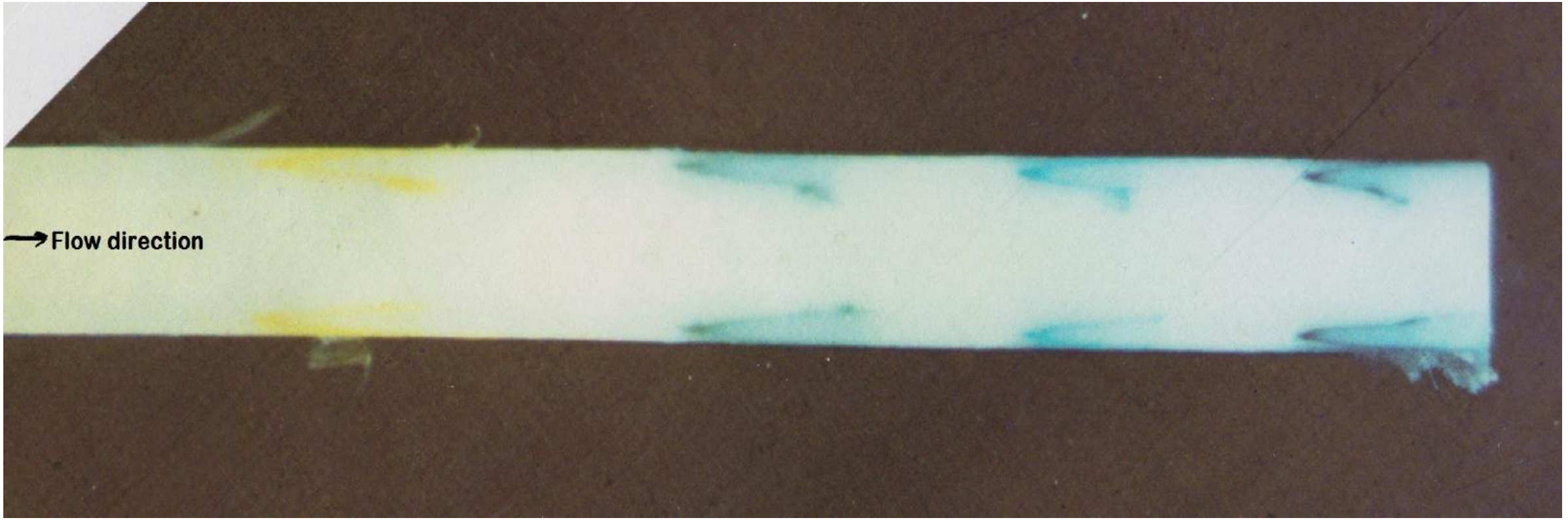
The first tracer to enter the mold was RED and RED appeared the closest to the gate!

The last tracer was BLACK and it went the furthest from the gate!

REVERSAL OF TRACER SEQUENCE!



Tracers became “V” shaped near the wall



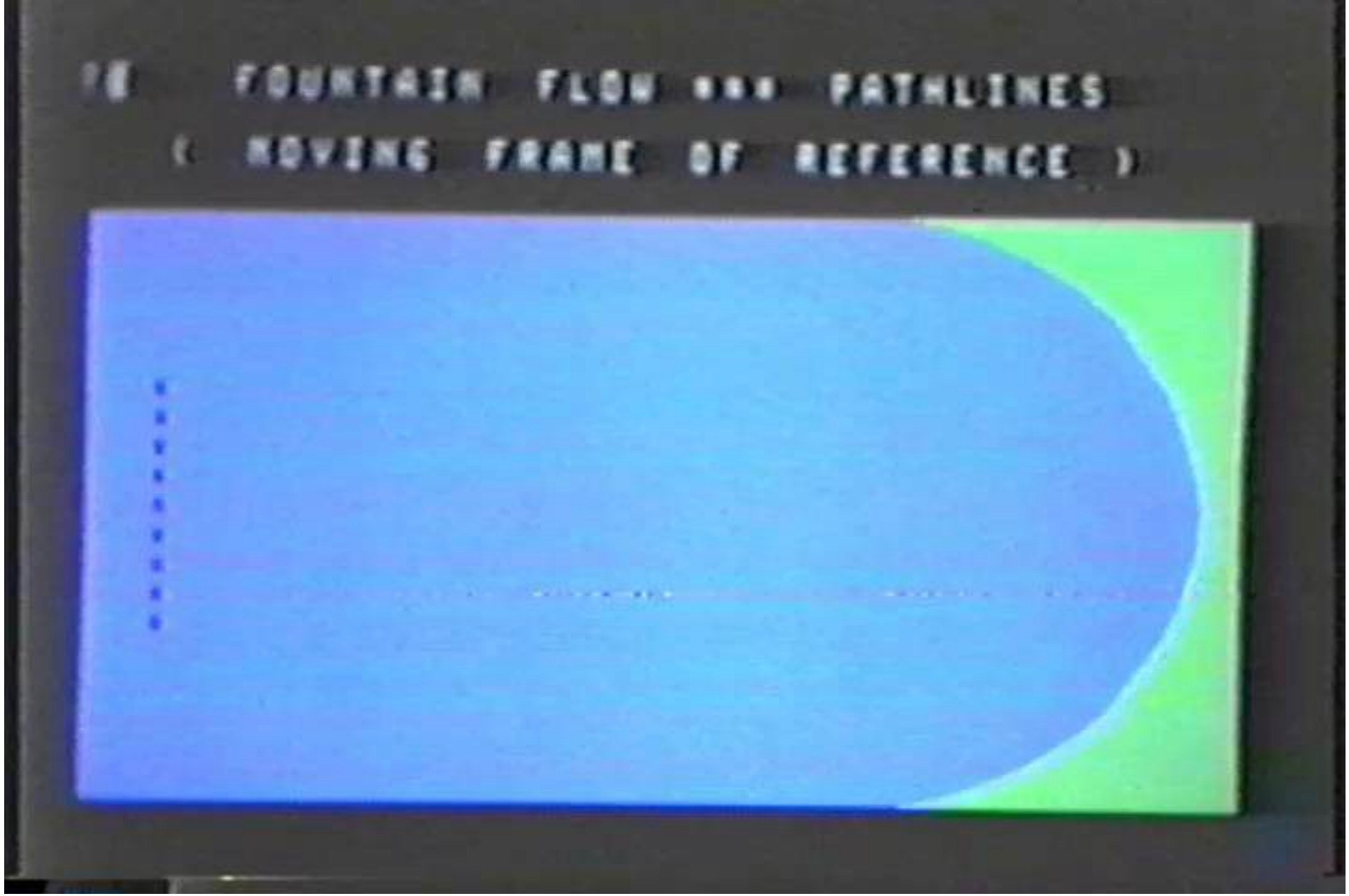
The computer visualization was produced in connection with the following three publications:

- Finite element simulation of fountain flow in injection molding
  H Mavridis, AN Hrymak, J Vlachopoulos

  Polymer Engineering & Science 26 (7), 449-454 (1986)
- Deformation and orientation of fluid elements behind an advancing flow front H Mavridis, AN Hrymak, J Vlachopoulos

  Journal of Rheology 30 (3), 555-563 (1986)
- The effect of fountain flow on molecular orientation in injection molding H Mavridis, AN Hrymak, J Vlachopoulos

  Journal of Rheology 32 (6), 639-663 (1988)


FOUNTAIN FLOW ••• PATHLINES
(MOVING FRAME OF REFERENCE)

What are the implications of fountain flow in injection molding?

- Various problems related to surface appearance and mechanical properties of IM products.
- The peculiar flow orientation usually results in problems related to dimensional specifications, due to release of frozen-in stresses at higher temperature environments
- Fountain flow instability results to the surface defect known as “tiger stripes”
- Fountain flow (stable or unstable) affects the mechanical integrity of parts at weldlines. Weldlines are lines of weakness, due to poor molecular bonding , which is further complicated by the peculiar flow pattern.