DAÑO INDUCIDO POR FLUIDOS DE PERFORACIÓN Y COMPLETAMIENTO

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CONTENIDO

1. Introducción
   - Definiciones y conceptos principales
   - Filtración y Radio de Invasión
   - Variables que afectan la tasa de filtración

2. Ecuaciones y procesos
   - Protocolos Experimentales
   - Deducción de las ecuaciones

Introducción

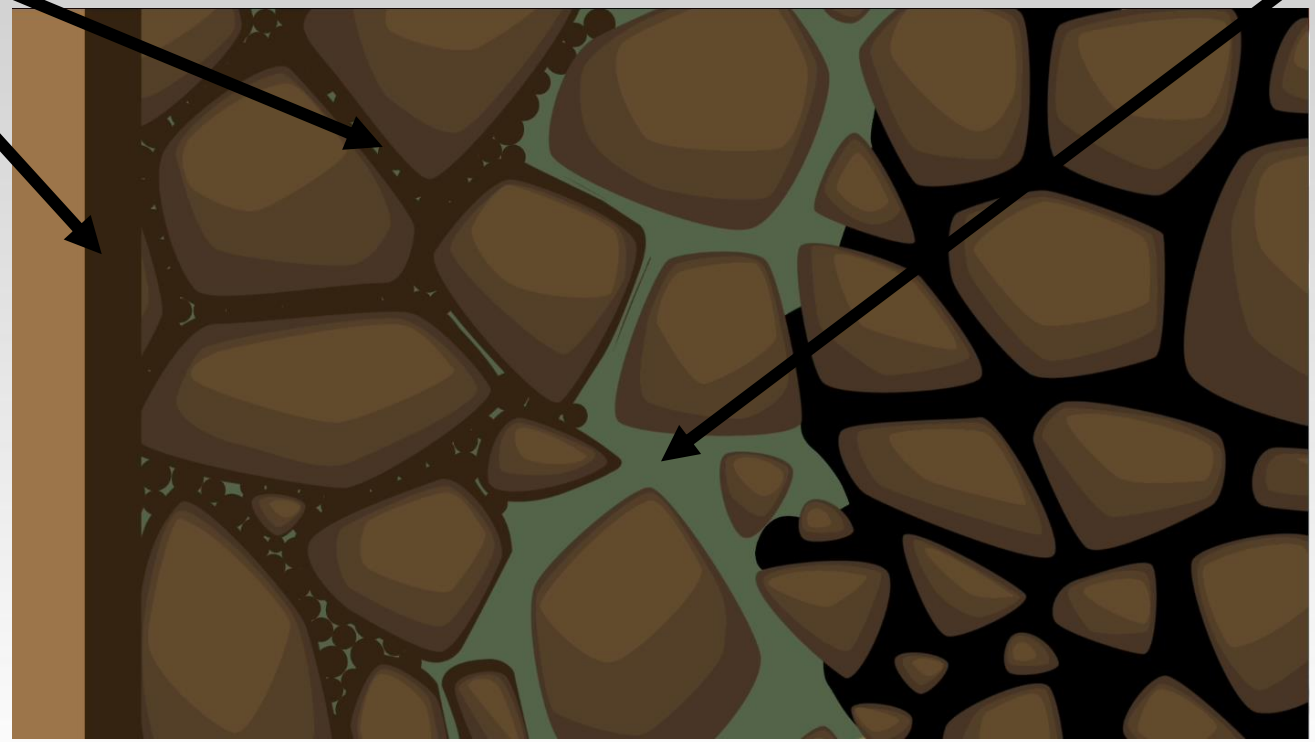
Revoque Externo e Interno

Invasión de partículas sólidas

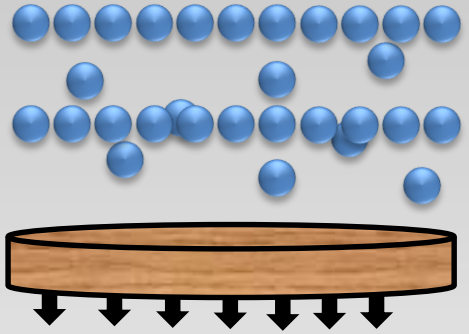
Zona invadida

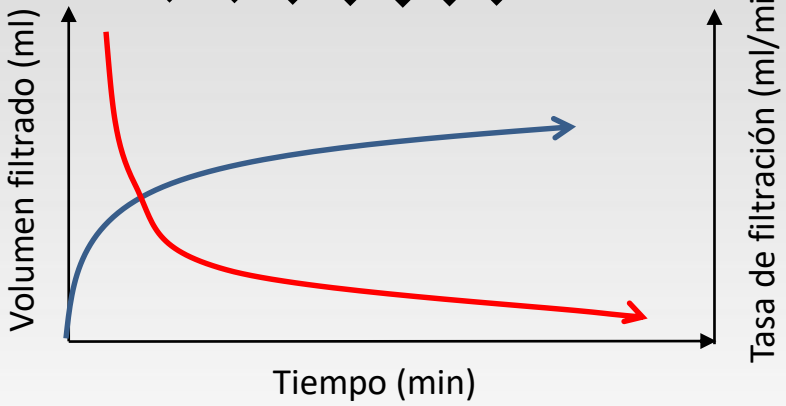
Invasión de filtrado (emulsiones, cambios de humectabilidad, etc.)

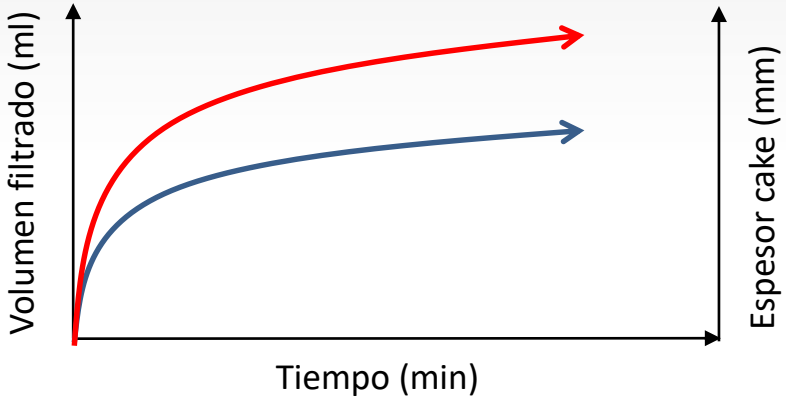
- Material de Puenteo



Filtración Estática

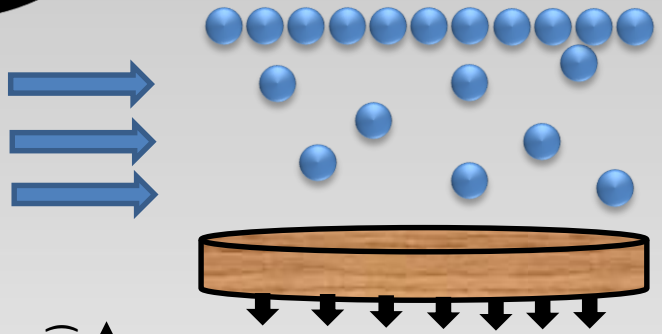


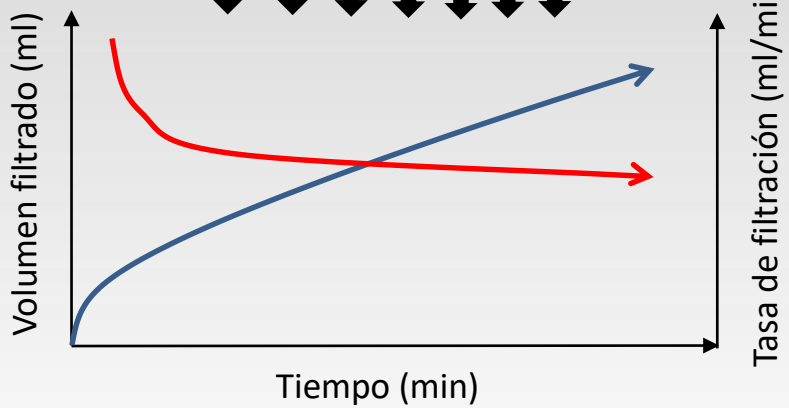


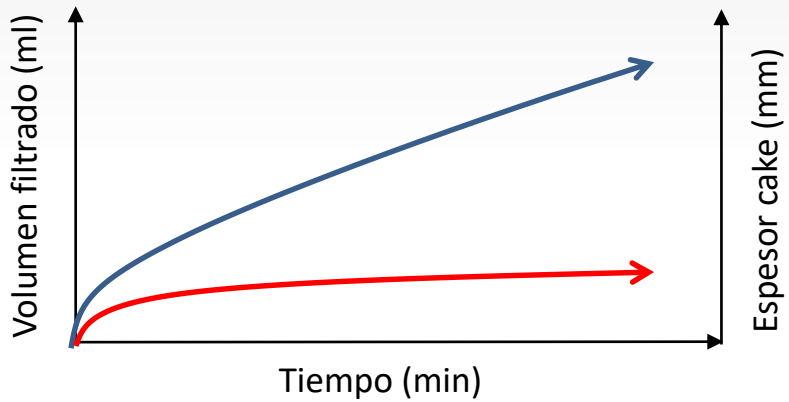


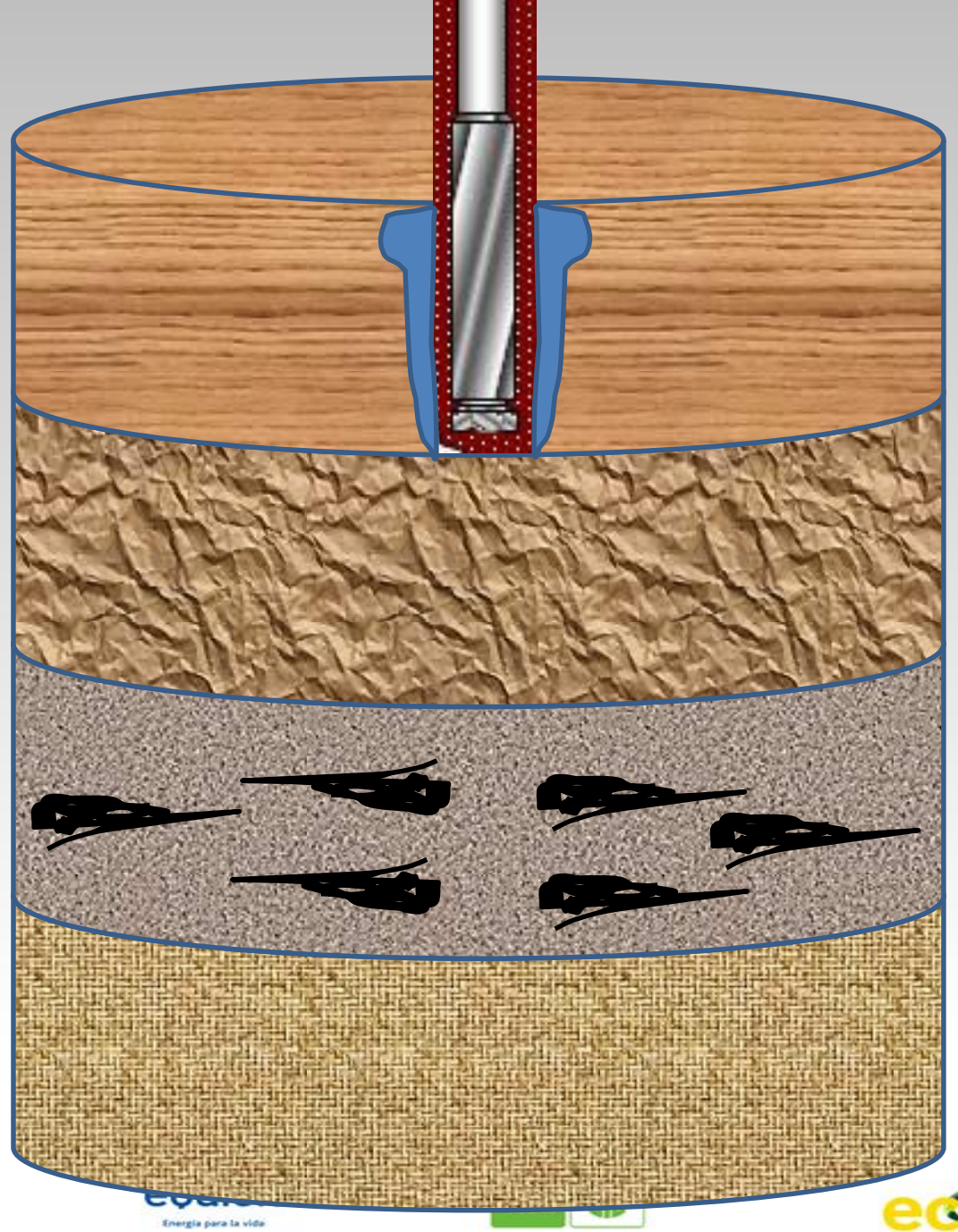
Volumen de Filtrado
Tasa de Filtración
Espesor del Cake

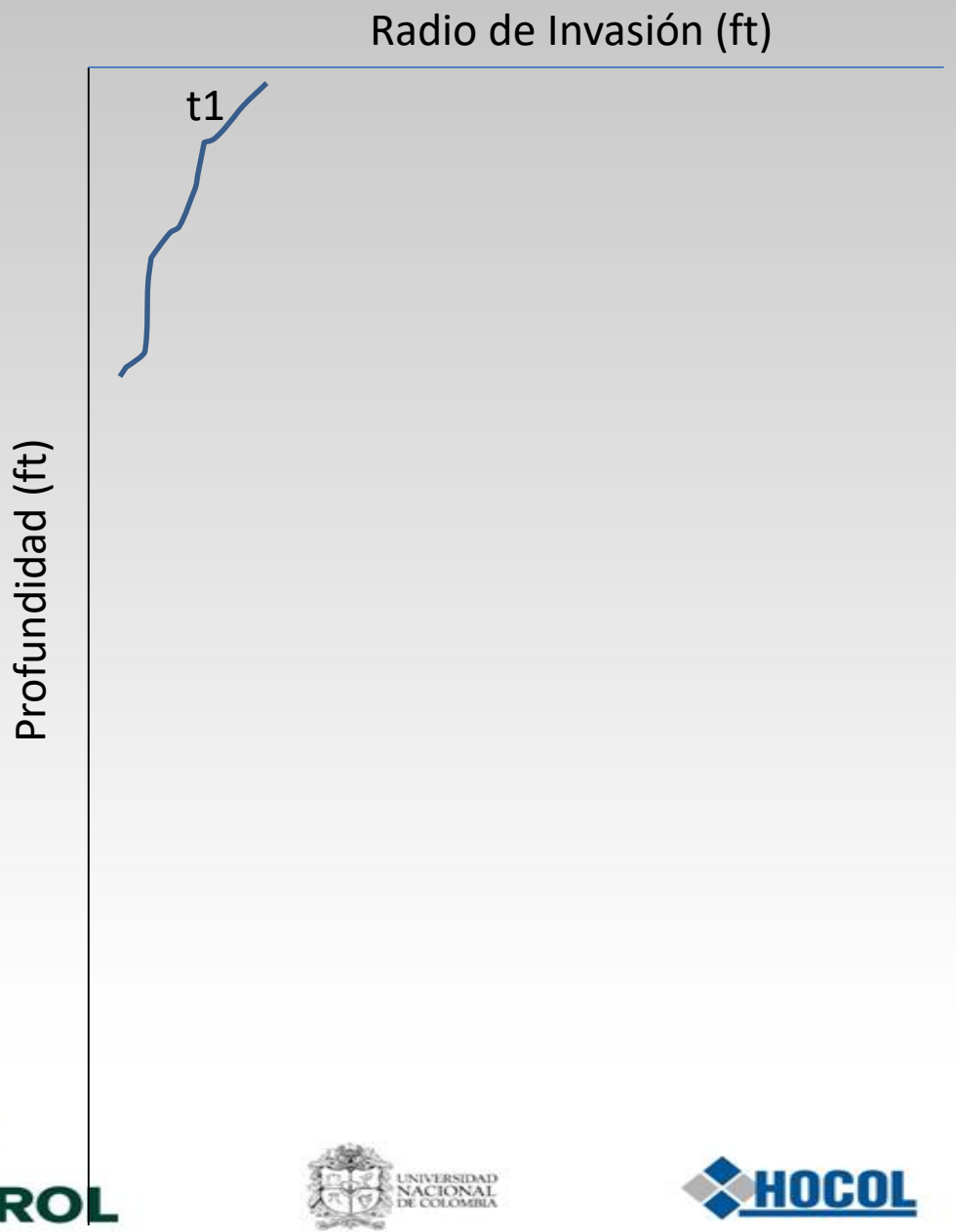
Filtración Dinámica

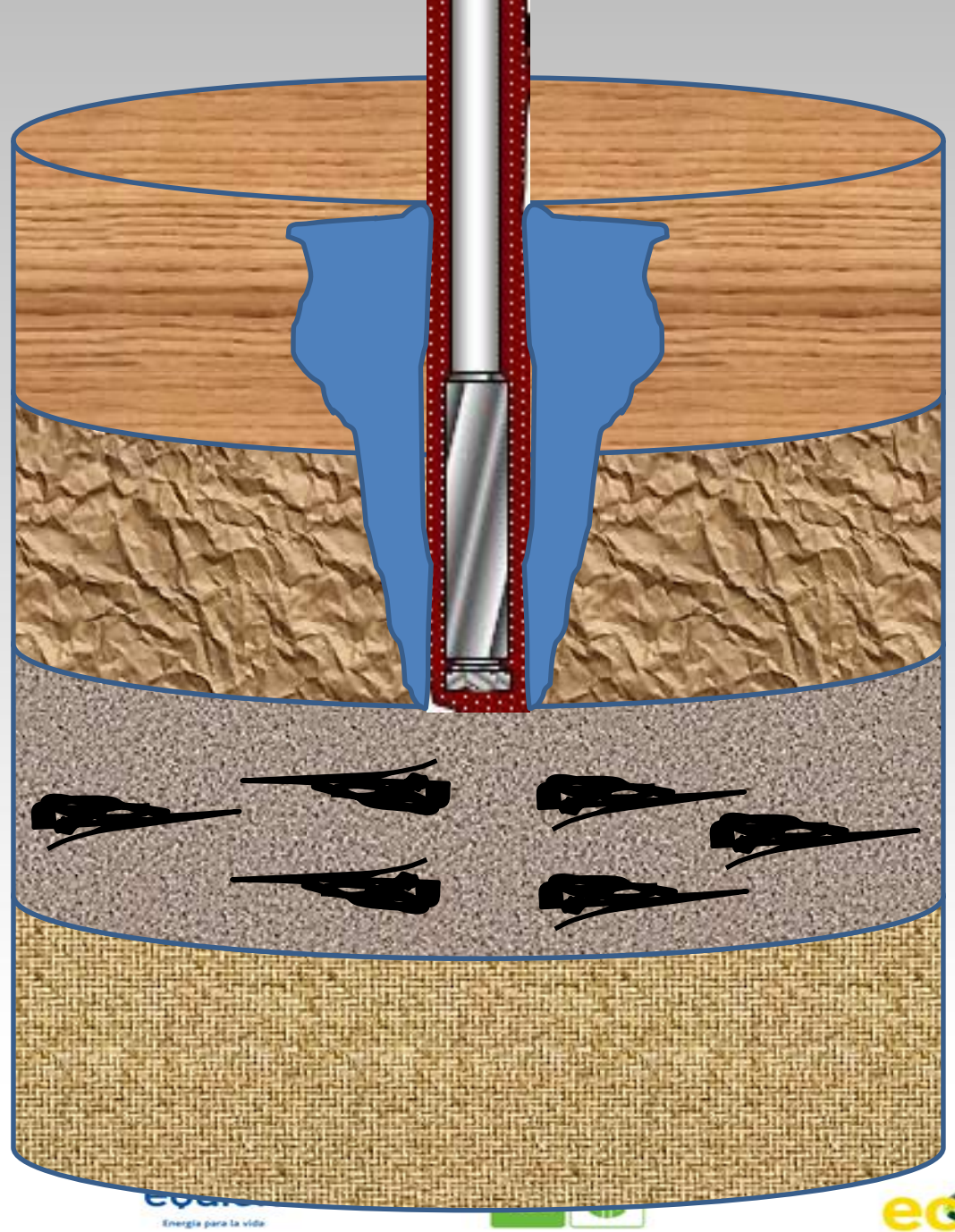


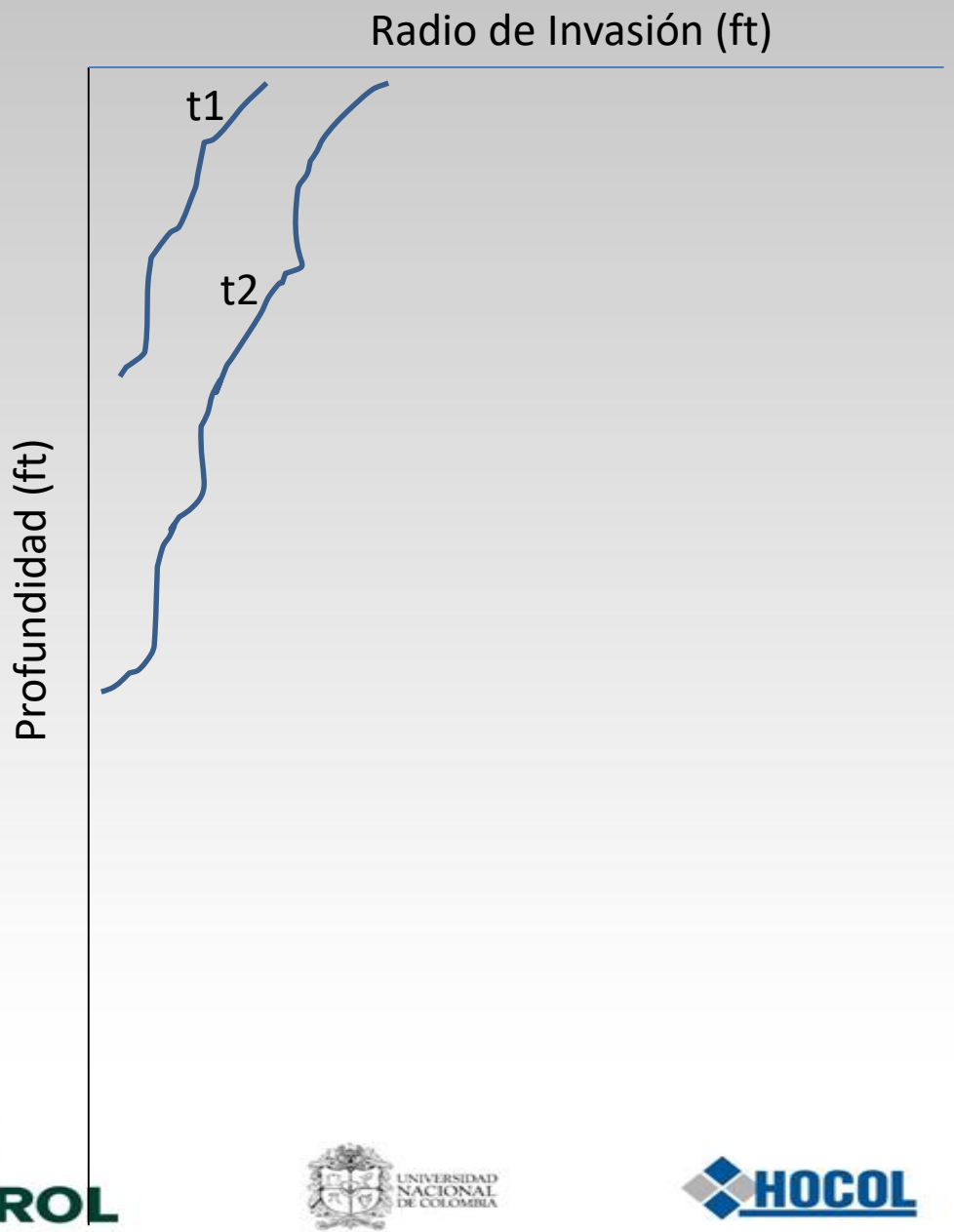


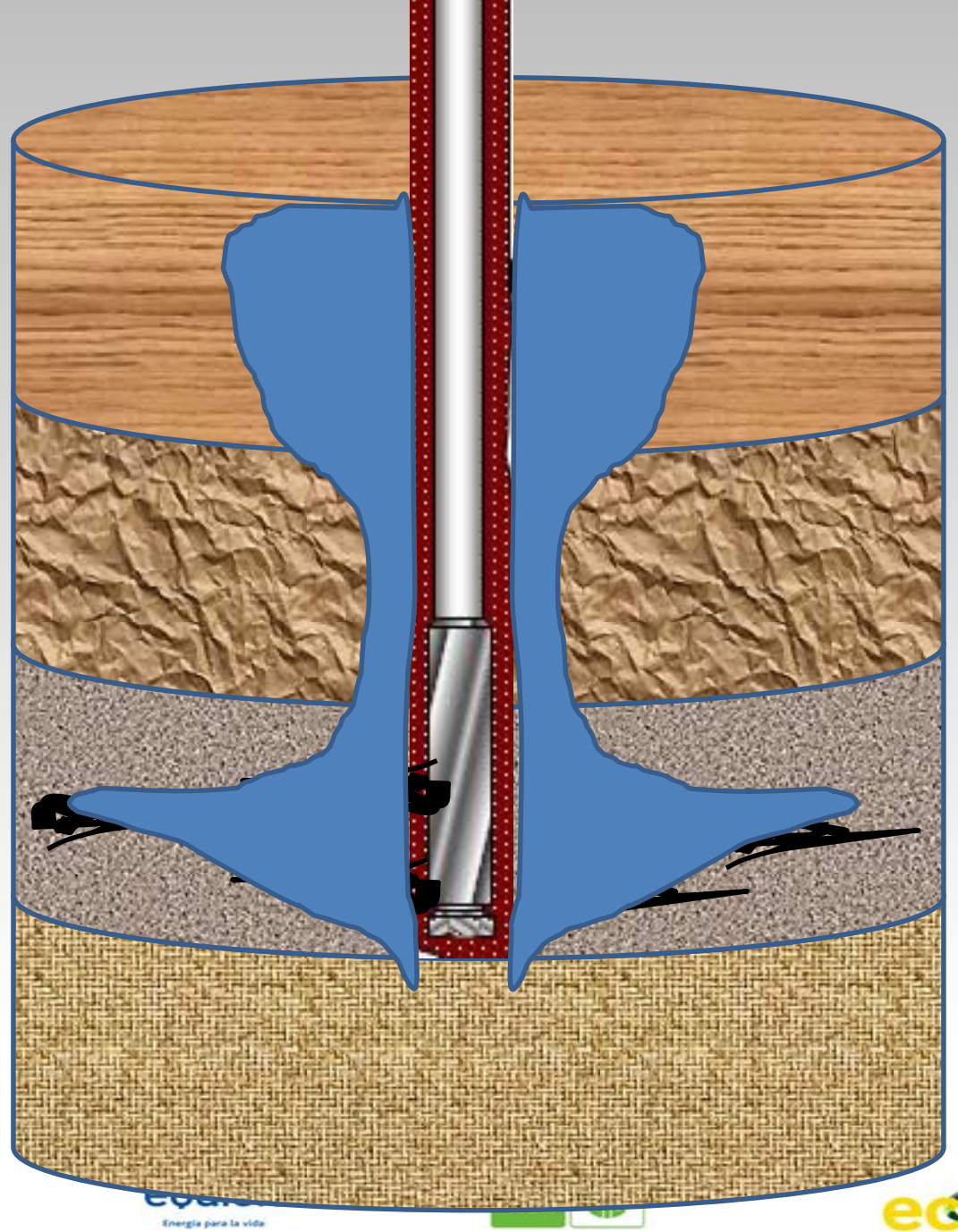


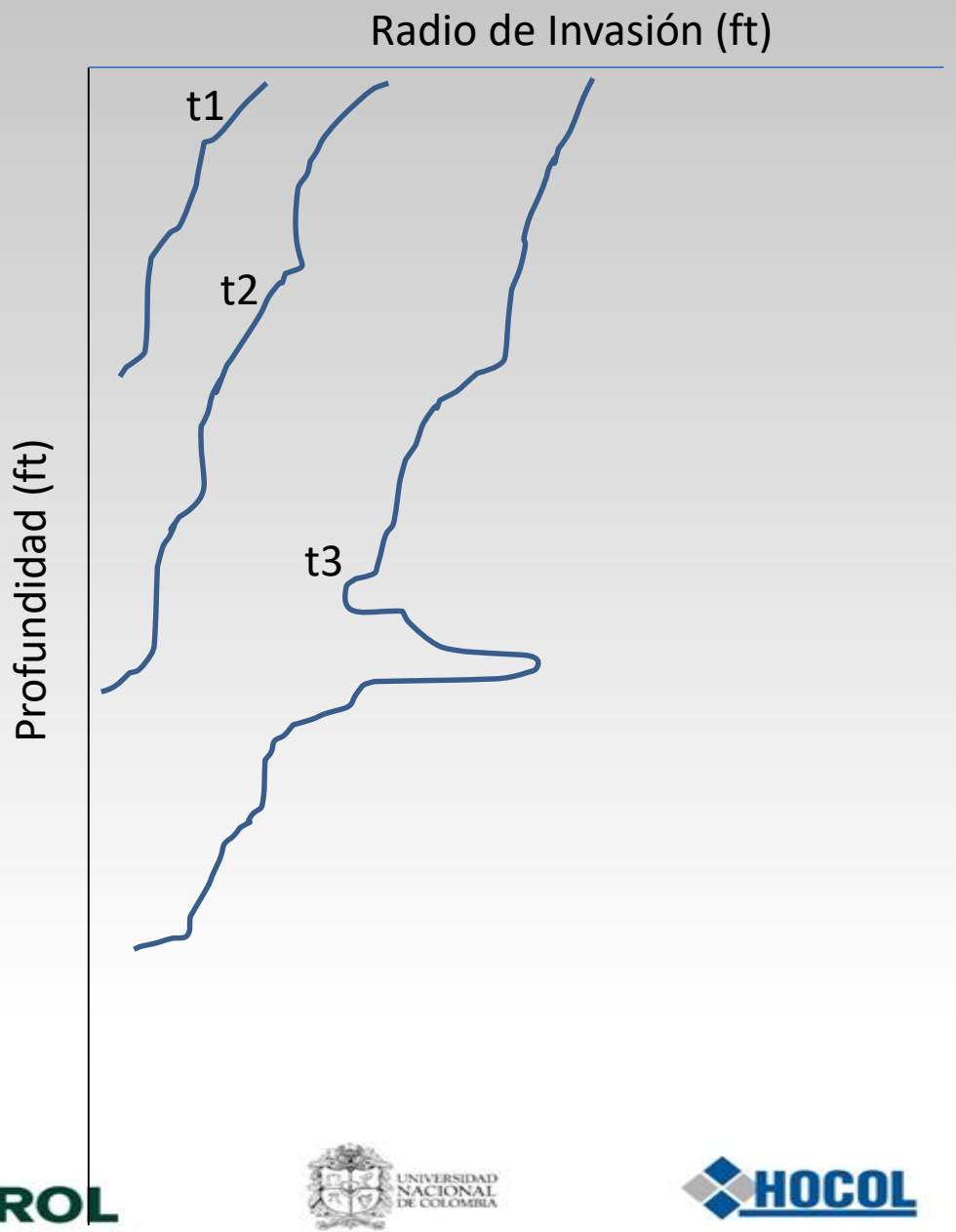


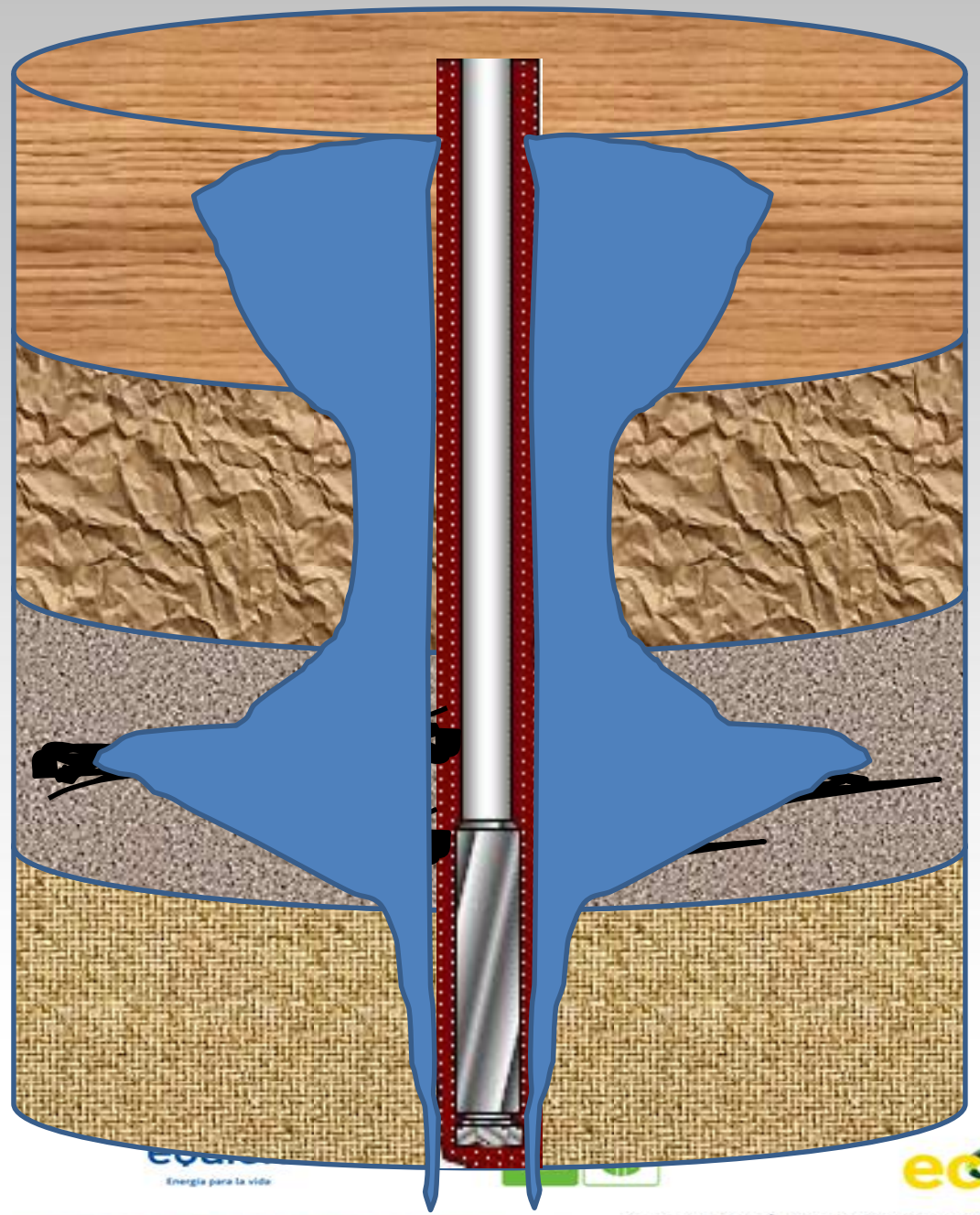

Radio de Invasión (ft)
t1
Profundidad (ft)

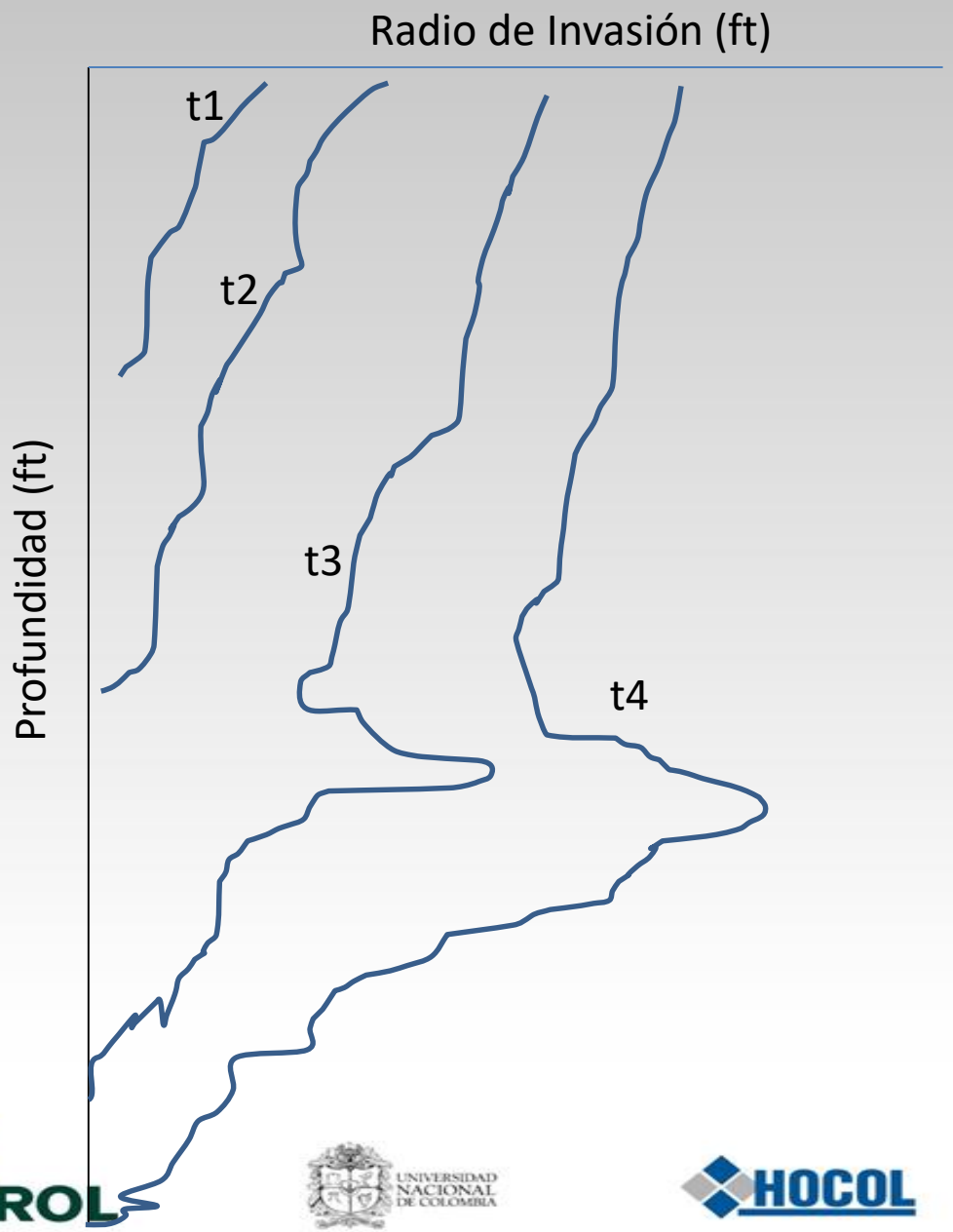


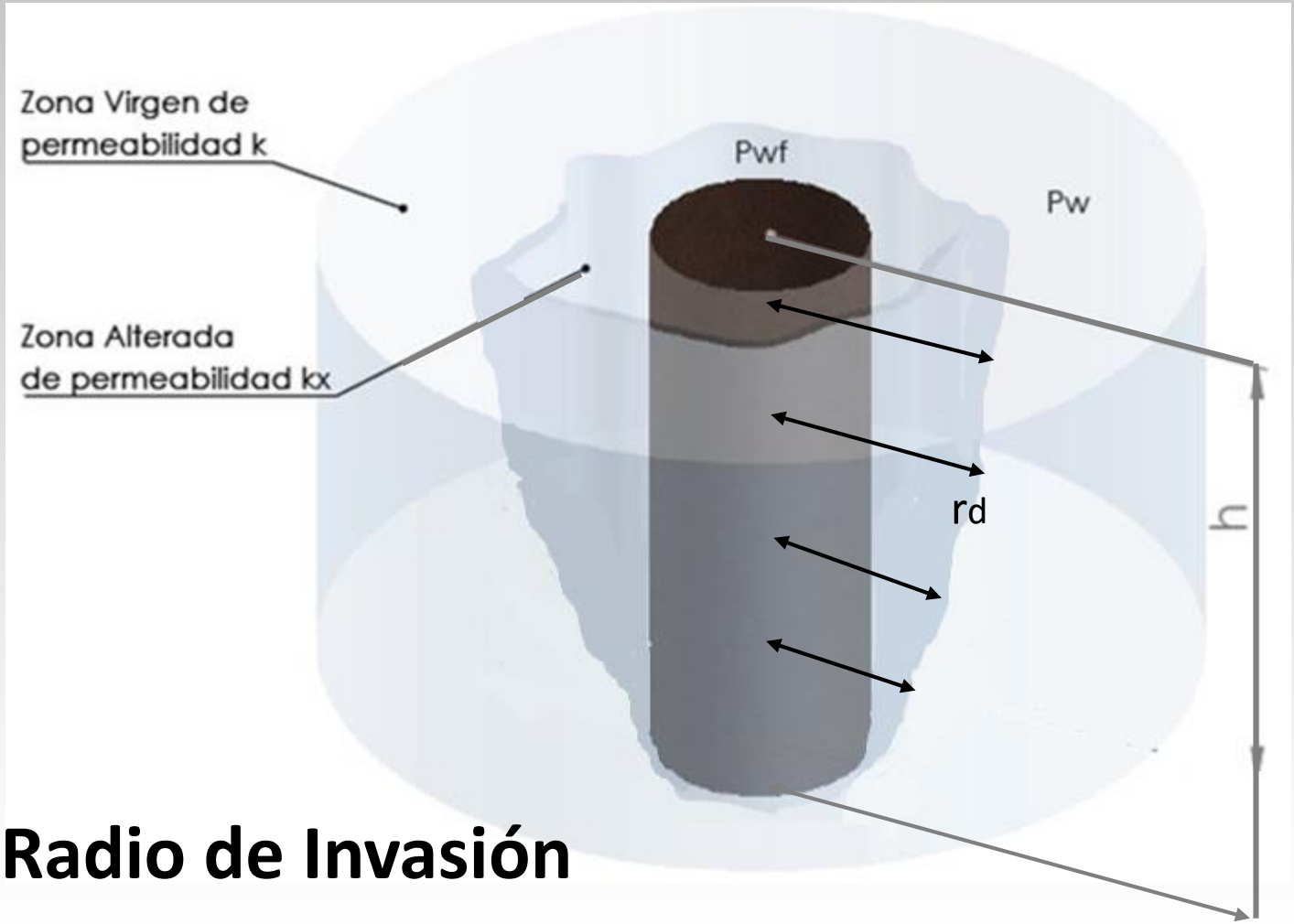

Radio de Invasión (ft)
t1
t2
Profundidad (ft)

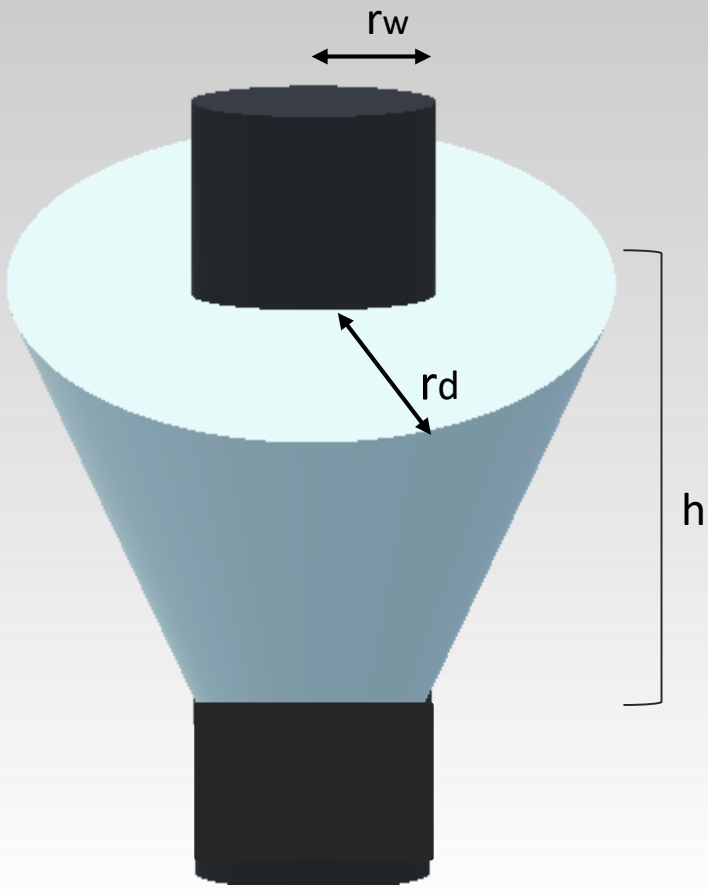



Radio de Invasión (ft)
Profundidad (ft)
t1
t2
t3

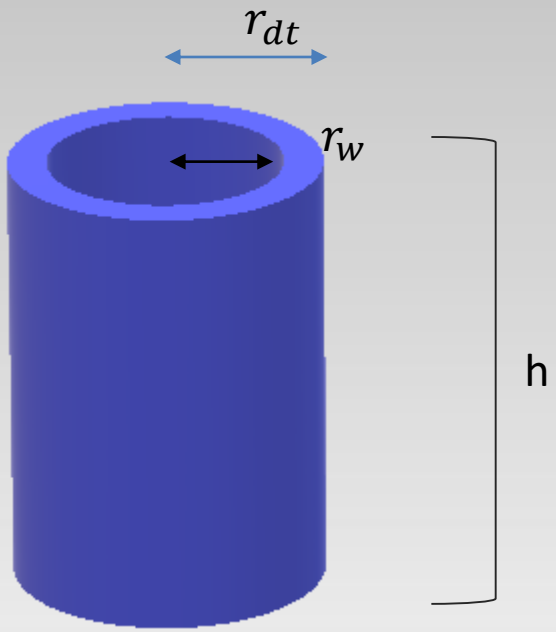


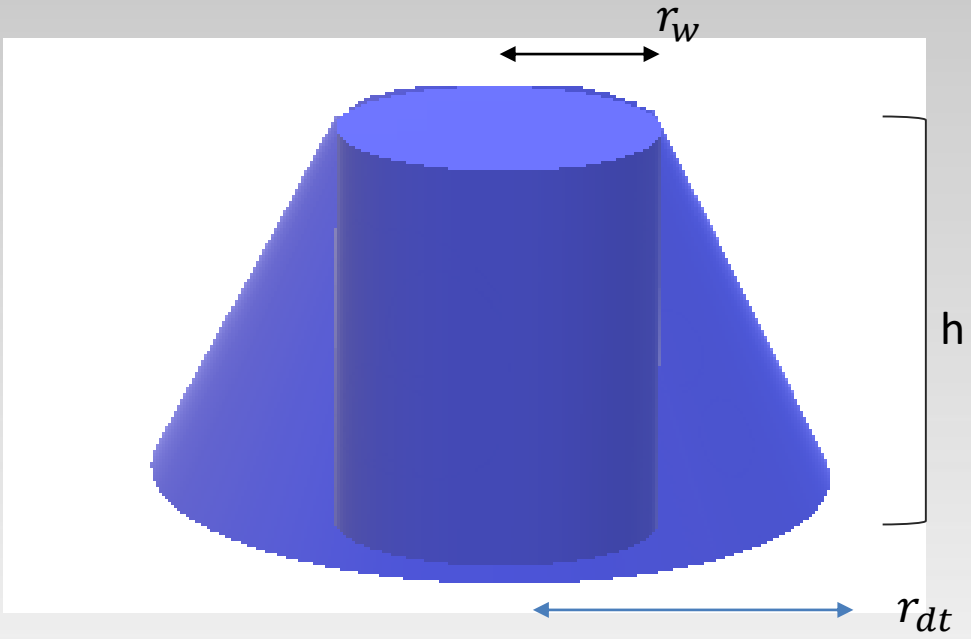

Radio de Invasión (ft)
Profundidad (ft)
t1
t2
t3
t4





Radio de Invasión





$$V_f = 2 * \pi * r_{dt} * h * (r_{dt} - r_w)$$

$$V_f = \frac{1}{3} * \pi * h * \left({r_{dt}}^2 + r_w^2 + (r_{dt} * r_w)\right) - \pi * r_w^2 * h$$

Cono

Cilindro

Radio de Invasión

Variables que afectan la tasa de filtración

- Permeabilidad
- Porosidad
- Tamaño de garganta
- Discontinuidades

- Sobrebalance
- Shear rate

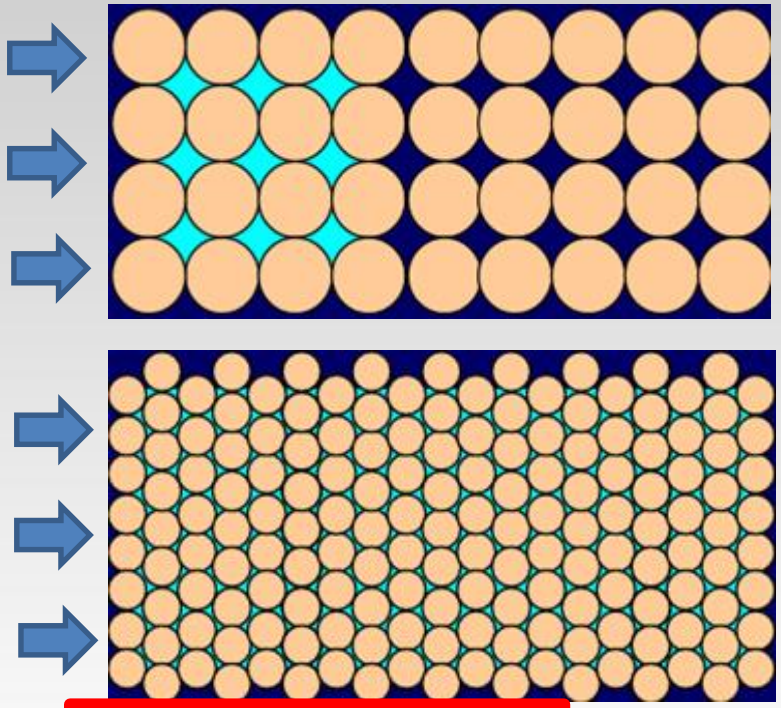
Tasa de filtración

Volumen de filtrado

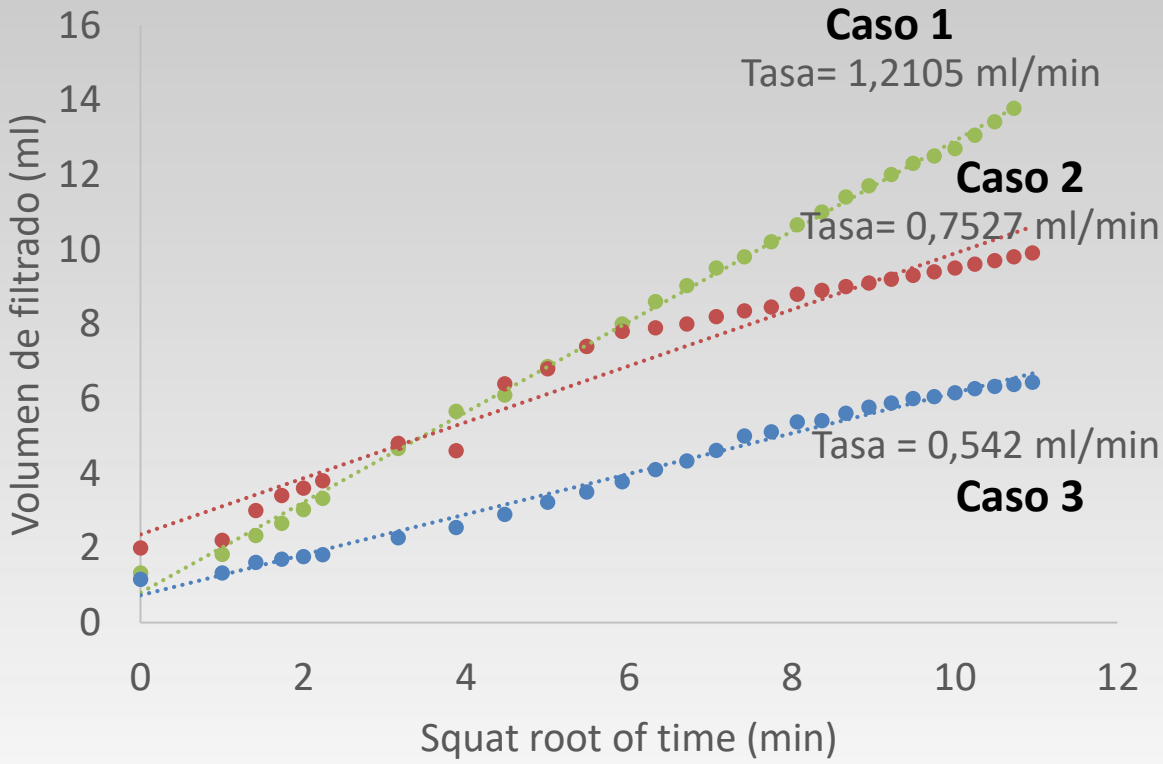
Radio de Invasión

Permeabilidad - Porosidad

Alta Permeabilidad Porosidad



Baja Permeabilidad Porosidad



Caso 1

400 mD

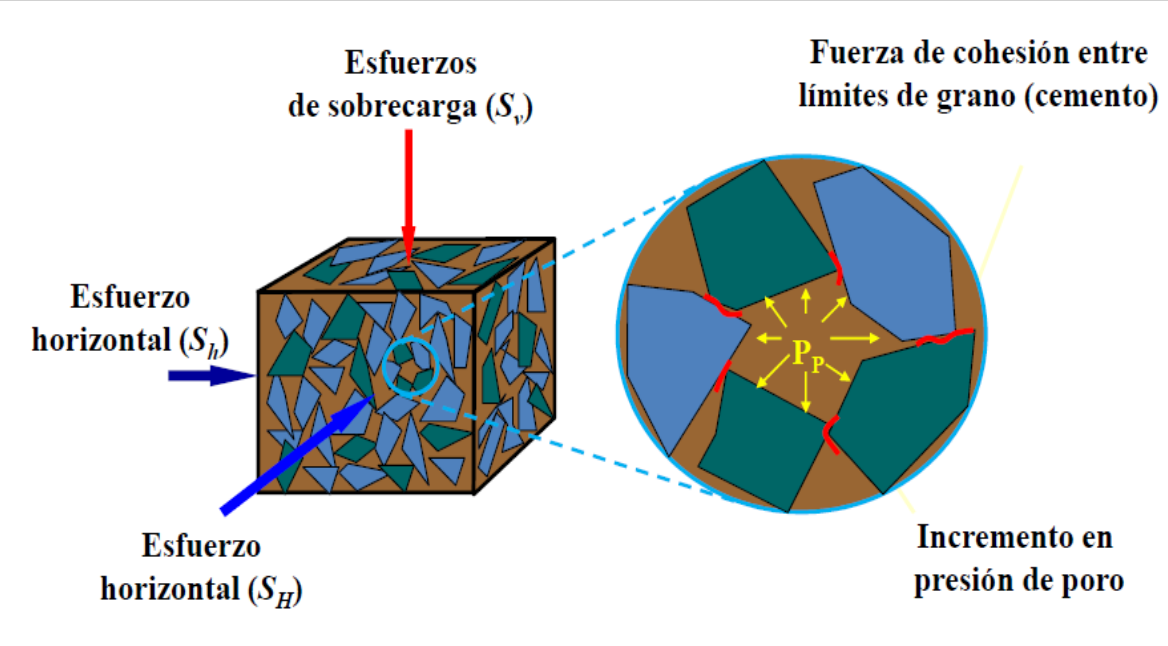
Caso 2

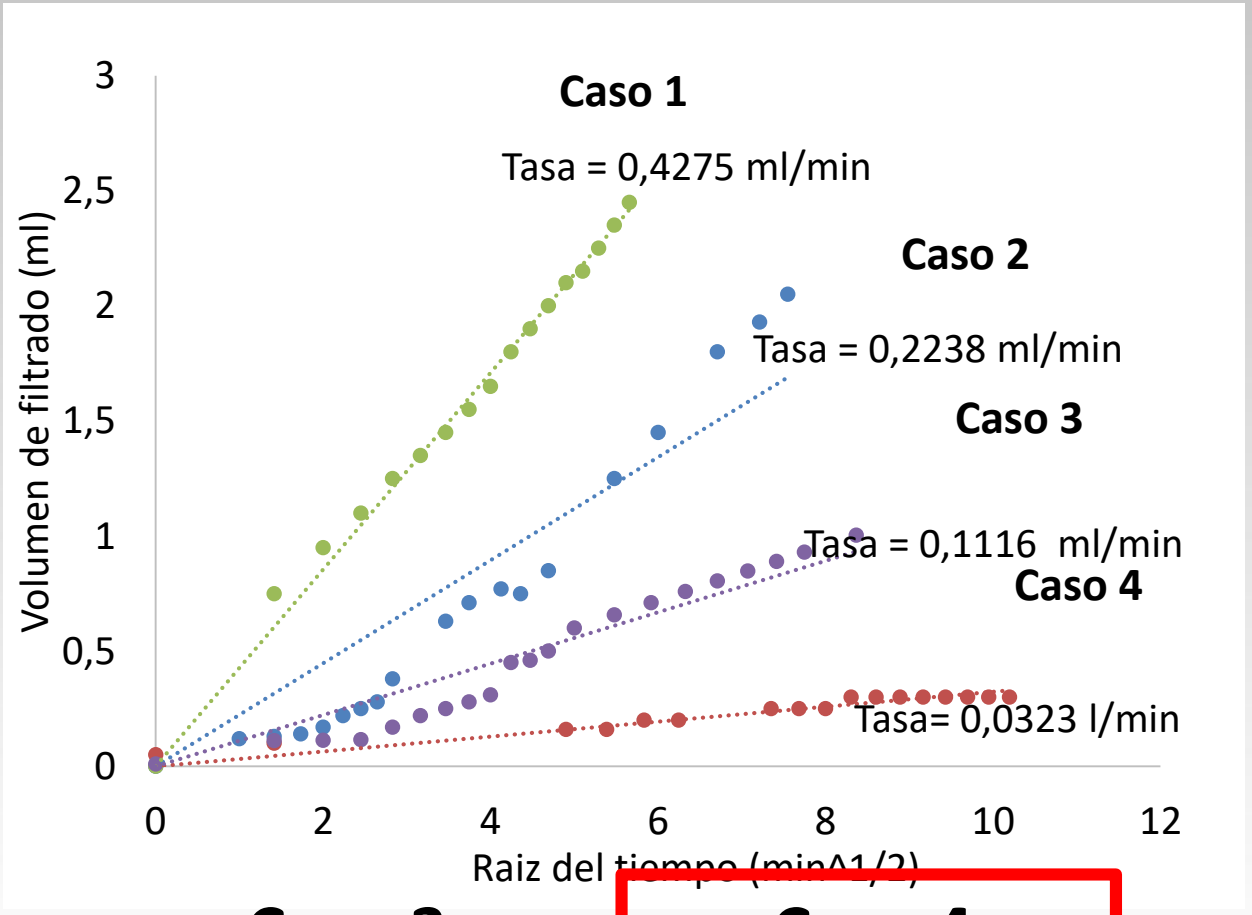
250 mD

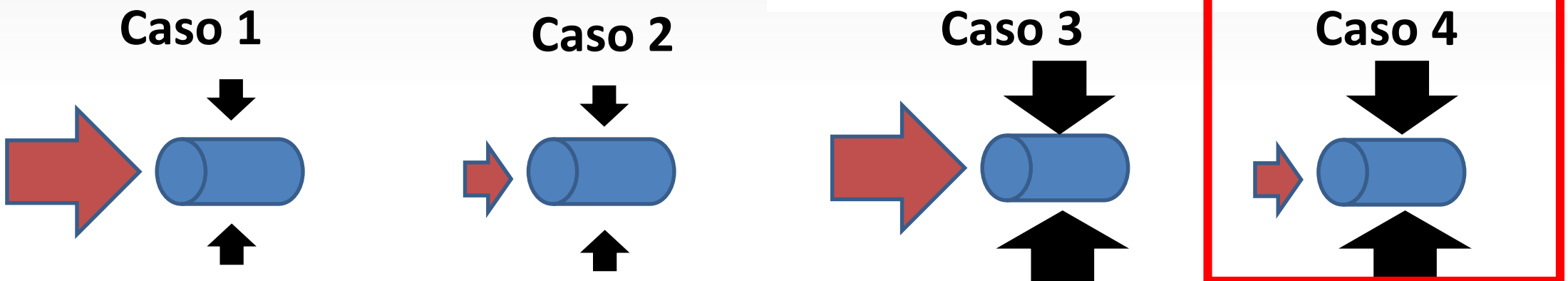
Caso 3

169 mD

Sobrebalance – Esfuerzos







Ecuaciones y Procesos

Pruebas Experimentales

Construcción del Modelo

Resultados

Prueba de desplazamiento

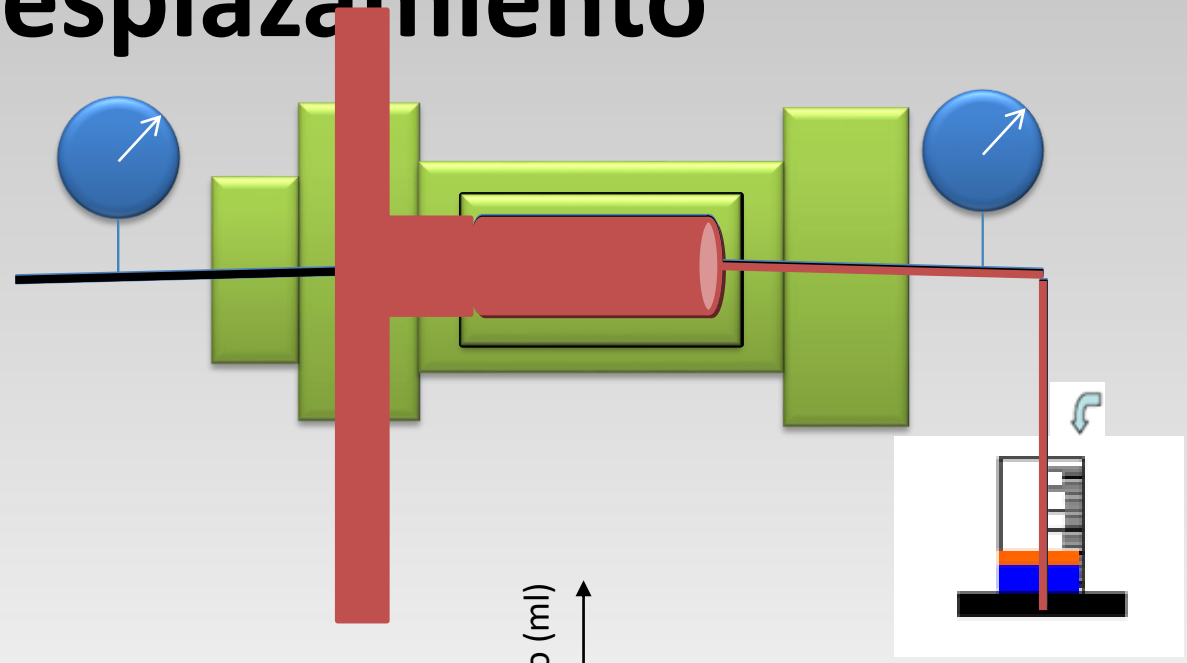
Permeabilidad absoluta

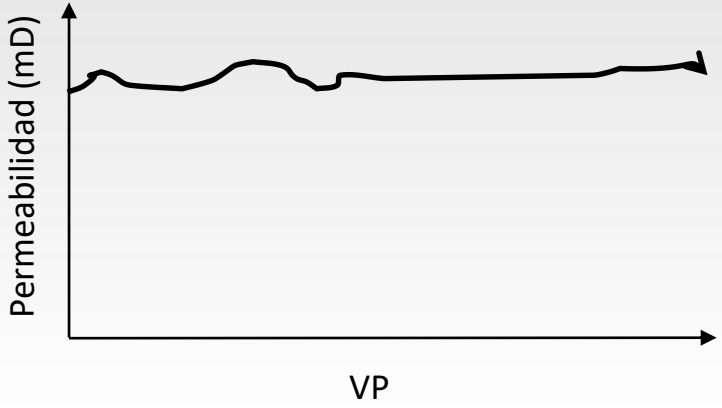
Permeabilidad efectiva al aceite

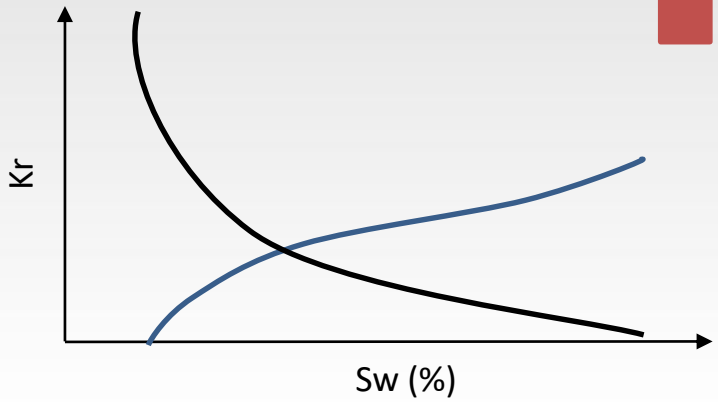
Curvas de permeabilidad relativa

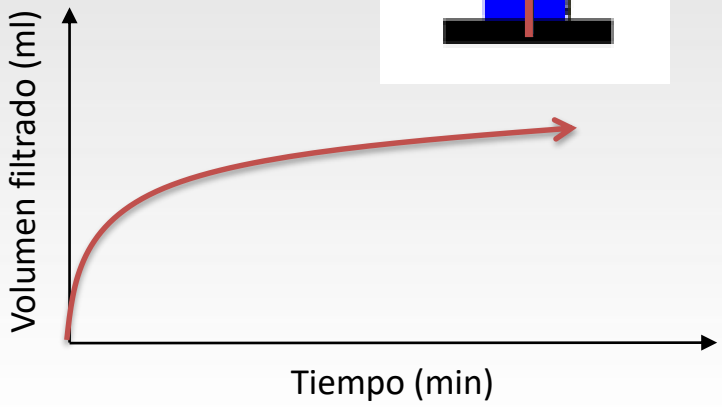
Saturación del medio

Daño por Fluido de Perforación









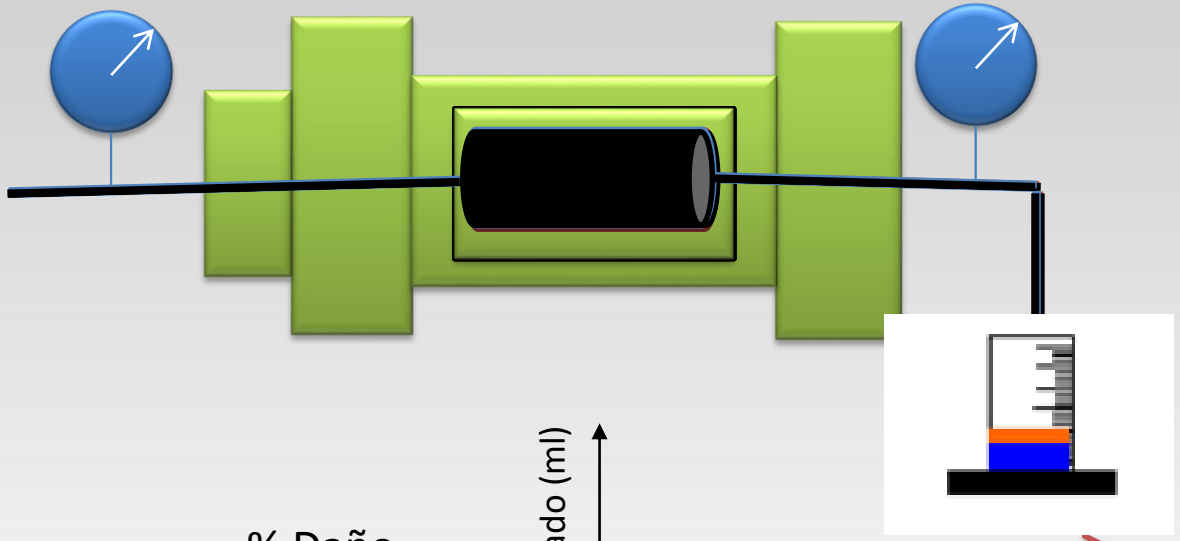
Prueba de desplazamiento

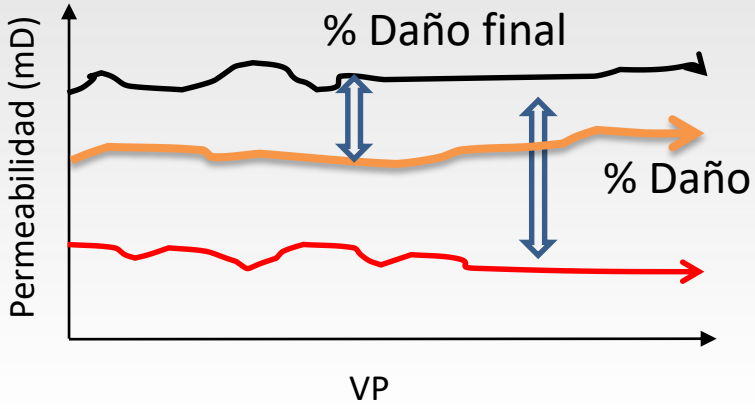
Daño por Fluido de Perforación

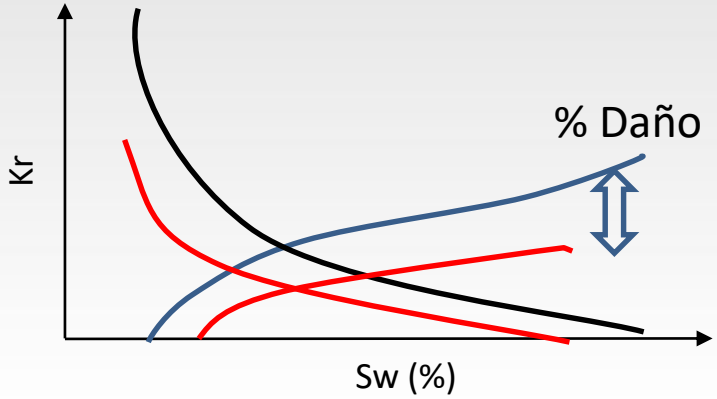
Permeabilidad efectiva al aceite - daño

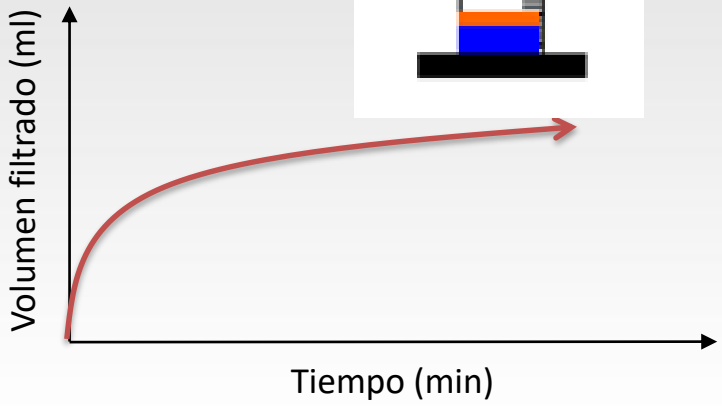
Curvas de permeabilidad relativa – daño

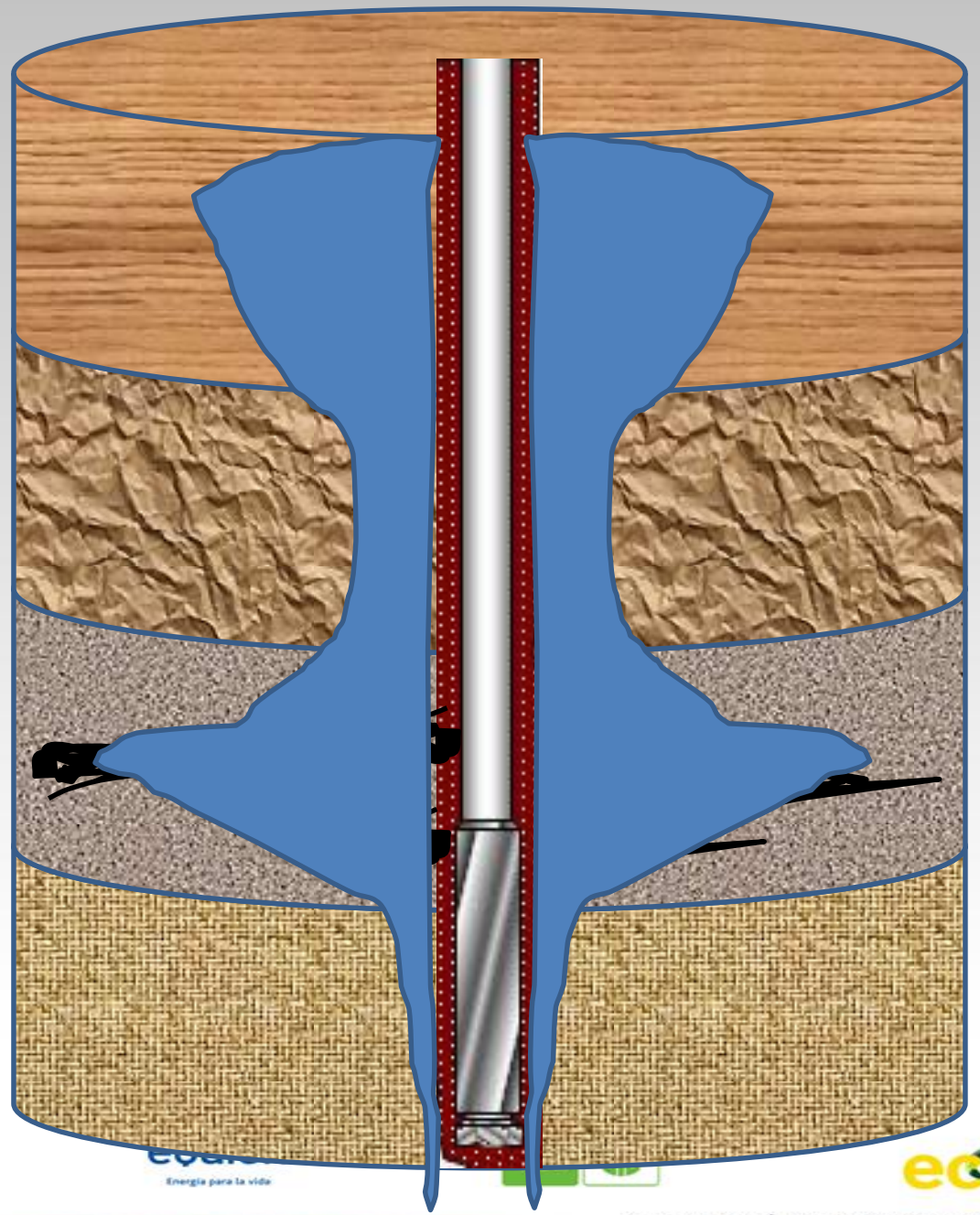
Retorno de permeabilidad al aceite

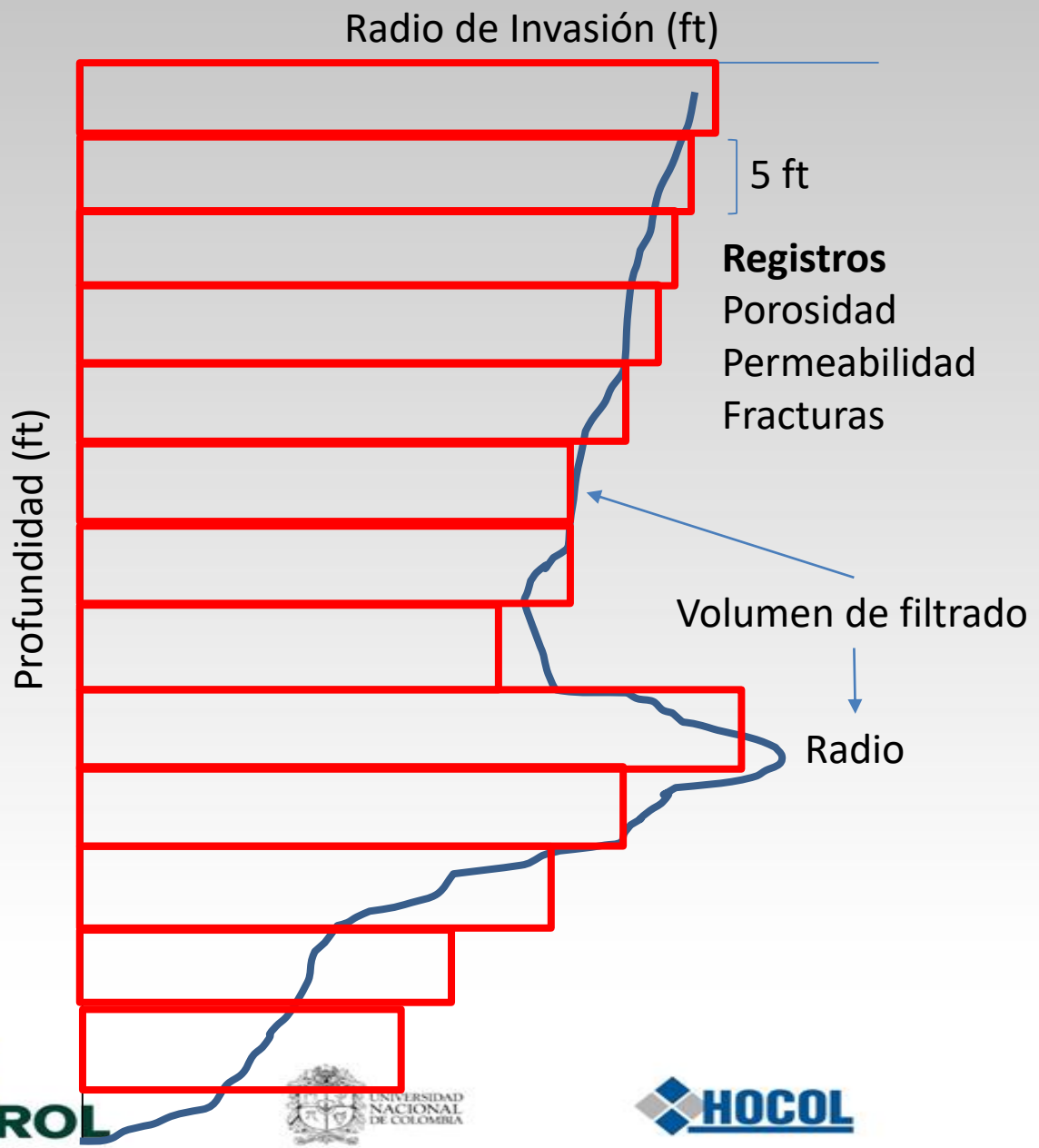




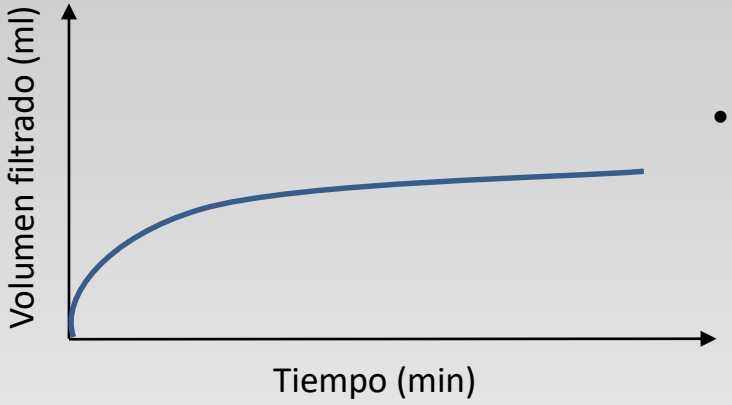






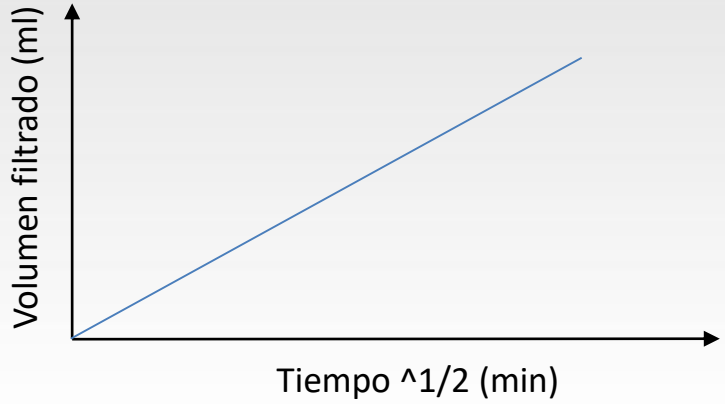

Radio de Invasión (ft)
5 ft
Registros
Porosidad
Permeabilidad
Fracturas
Profundidad (ft)
Volumen de filtrado
Radio

Construcción del Modelo



- **Calculo r_d** $r_d = \left[r_w^2 + \frac{V_f}{\pi h \varphi (1 - S_{irr})}\right]^{0.5}$

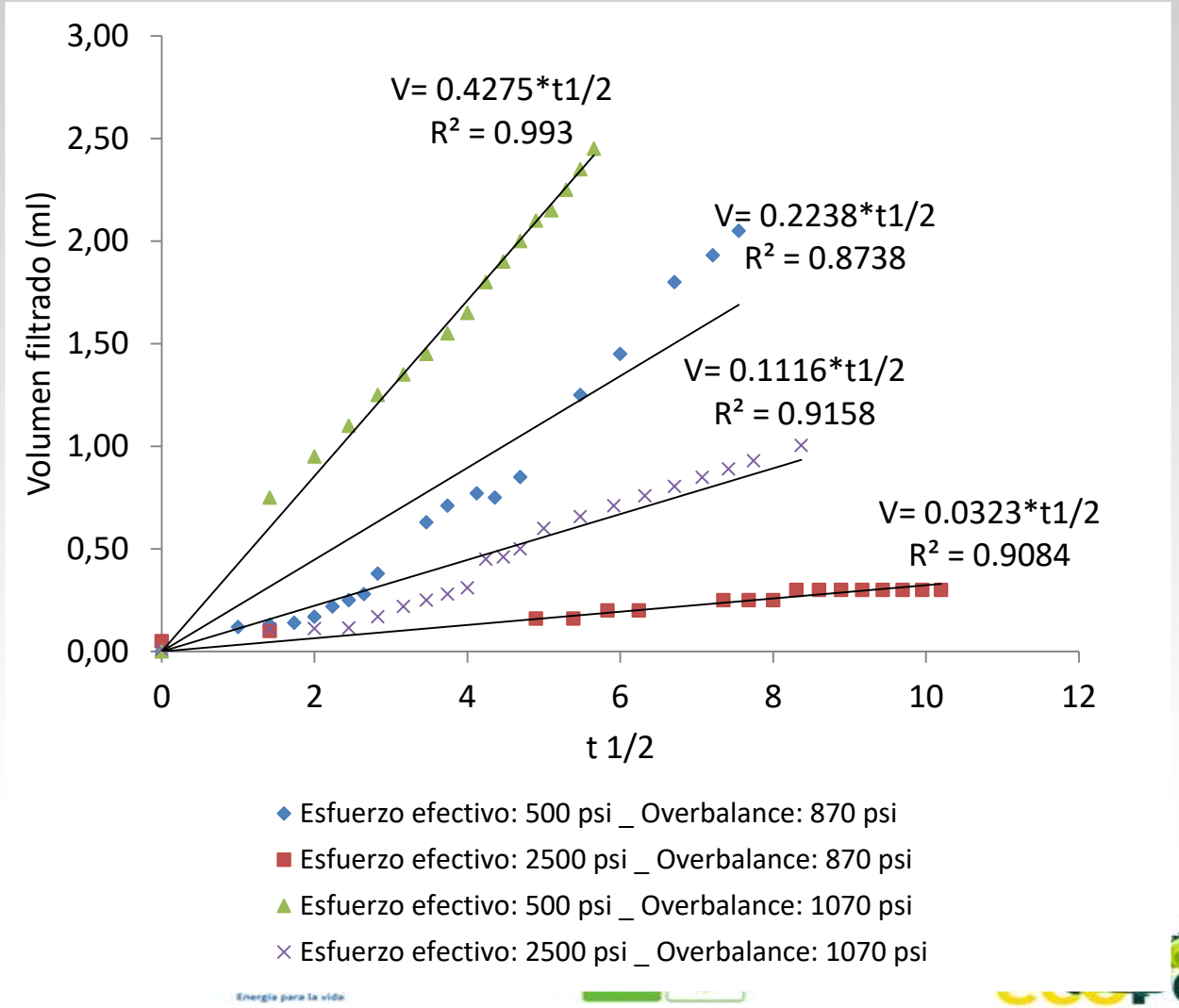
$$V = C * t^{1/2} \Rightarrow C = dV/dt^{1/2} \Rightarrow \frac{dV}{dt^{1/2}} = A * (K * P_{OB}) + B$$

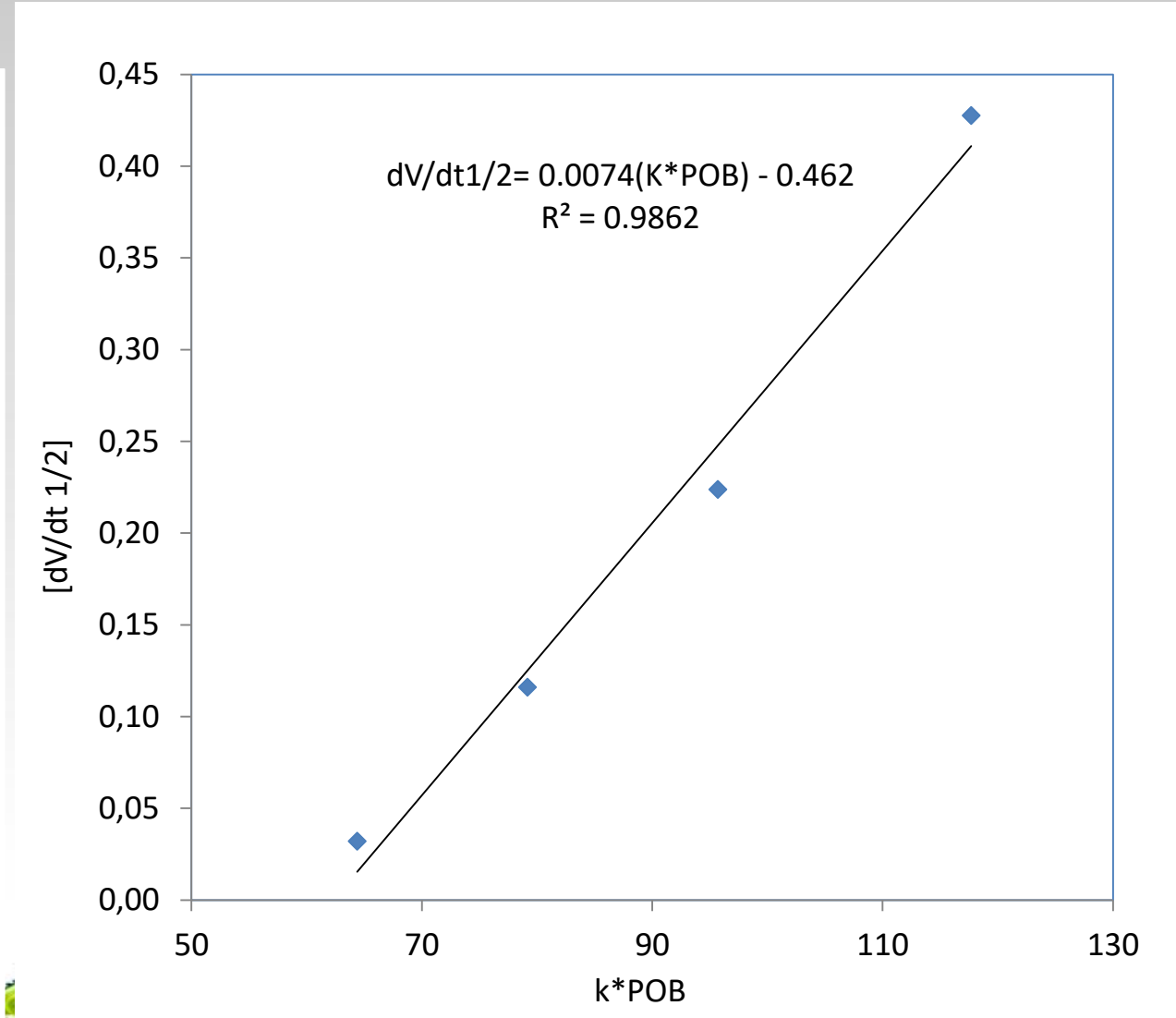


$$V = (A * (K * P_{OB}) + B) * t^{1/2}$$

- **Calculo Skin** $S = \left(\frac{K_i}{K_d} - 1\right) \ln \frac{r_d}{r_w}$

Construcción del Modelo





Construcción del Modelo

Database – Filtration Function

1. Parameter A y B
2. Experimental results

Project Management - Scenario

1. General Data: Formation, Field, etc.
2. Profile: Depth vs K, Φ, Fracture, Swr
   Average: K, Φ, Fracture, Swr
3. Drilling and Cementing Information
4. Define Filtration Functions

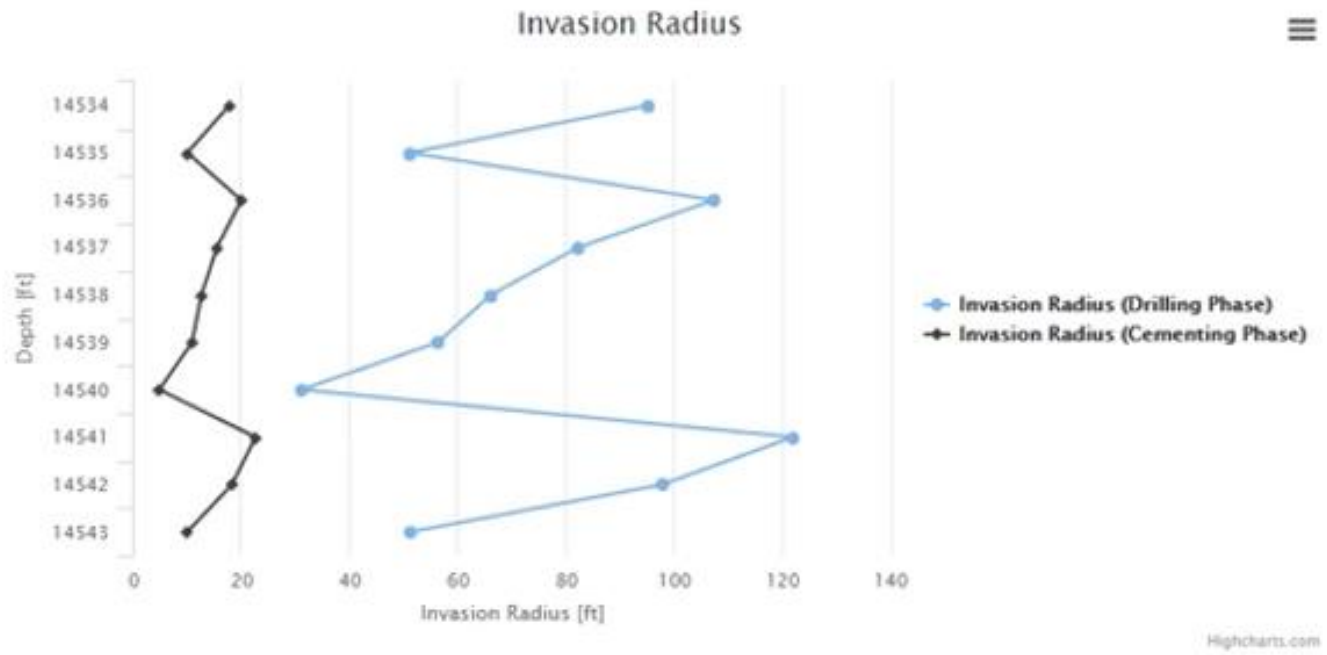
Drilling and Cementing Information: Total exposure time, Mud and slurry density, Pump rate.

Results

1. Skin
2. Total invasion volume
3. Invasion radius

Profile and average: Drilling and Cementing Section

Results



Drilling Phase

Maximum Calculated Skin [-]	Average Calculated Skin [-]	Total Invasion Volume (bbl)	Maximum Invasion Radius (ft)	Average Invasion Radius (ft)
6.11	5.56	759.69	121.90	759.69

Cementing Phase

Maximum Calculated Skin [-]	Average Calculated Skin [-]	Total Invasion Volume (bbl)	Maximum Invasion Radius (ft)	Average Invasion Radius (ft)
17.68	15.47	141.08	22.48	141.08

Agradecimientos

Ecopetrol – Equion – Hocol

Universidad Nacional

Gestores Técnicos

Profesores y estudiantes

¿Preguntas?