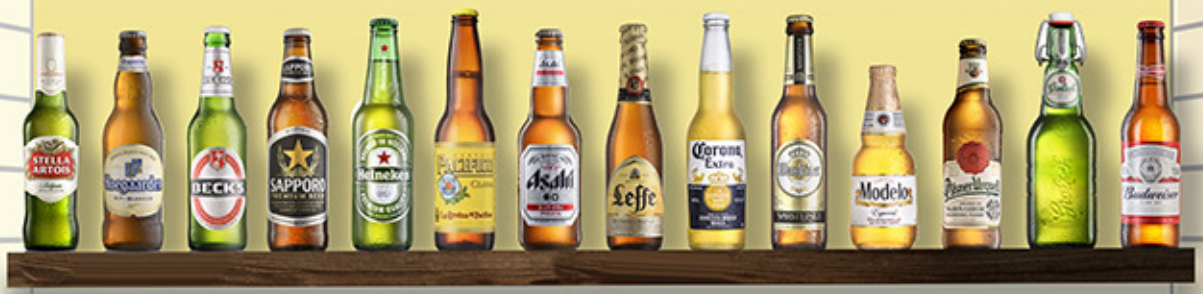
Oneness in nature: Beer foam, oil production and the universe



$$h^{th}(t) = h(0)\left(1 - \frac{t}{T}\right)\theta(T - t)$$

What do end-stage oil production and beer foam have in common? They both exponentially decline.

Twenty years ago, students at the Ludwig Maximilian University of Munich demonstrated exponential decay of volumes of beer froth. They measured the height of the "head" for several brands of beer.

Arnd Leike, at the university, designed the experiment and wrote a paper.

In the oil industry, another term for exponential decline is terminal decline. For tight wells, it bolts on to the Arps hyperbolic model as the exponential tail. Petroleum reserves engineers also use a "stretched" exponential production decline (SEPD) model to estimate future production from tight, fractured formations.

Surprisingly, decay in an electrical charge is an analog for SEPD. The model is based on the exponential decay of an electrical charge in a capacitor under a constant external load.

Other exponential-decay phenomena occur in geophysics, heat transfer, chemical reactions, luminescence, physical optics, pharmacology and toxicology, radioactivity, thermoelectricity and vibrations. Outside the world of physics,

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financial funds, with monthly payouts, experience an organic exponential decrease. The Internet makes use of an exponential-decay model to decrease routing failures (flapping) on the World Wide Web.

Using radioactive decay as an example, the basic formula is as follows: N is the size of a population of radioactive atoms at a given time t, and dN is the population decrease in time dt. Rate of change is generated by the equation, $dN/dt = -\lambda N$, where λ is the decay constant.

The simple, yet powerful equation models decays and associated declines that change the world in big and small ways.