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## Kind Of A Drag - How DRAs Are Changing The Economics Of Pipeline Takeaway Capacity

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The ability to increase the capacity of existing and planned crude oil pipelines with minimal capital expense has genuine appeal to midstream companies, producers and shippers alike. Enter drag reducing agents: special, long-chain polymers that are injected into crude oil pipelines to reduce turbulence, and thereby increase the pipes' capacity, trim pumping costs or a combination of the two. DRAs are used extensively on refined products pipelines too. Today we continue our look at efforts to optimize pipeline efficiency and minimize capex through the expanded use of crude-oil and refined-product flow improvers.

During most of the Shale Era, the U.S. and Canadian midstream sectors have been playing a game of catch-up—building new pipelines, expanding capacity and/or reversing flows on existing pipes, even converting pipelines from one hydrocarbon to another, all with the aim of bringing the capabilities of North American pipeline networks in line with the fast-evolving needs of producers and shippers. That work is far from done, as evidenced (on the crude oil side of things) by the soon-to-open Dakota Access Pipeline (DAPL; see [What a Difference a DAPL Makes](#)) out of the Bakken and plans for new takeaway capacity out of the Permian Basin and the Alberta oil sands ([What Is It? It's EPIC](#) and [One Is the Loneliest Customer](#)). But there's also a lot of anxiety among midstream companies, producers and shippers—a fear (also common to a lot of guys in their twenties) of commitment, or more specifically a palpable wariness about committing to more pipeline capacity than may be needed three months (or three years) from now.

Drag reducing agents help to ease some of that, well, unease by adding a degree of flexibility to the carrying capacity of crude oil (and refined product) pipelines, and at a relatively modest cost. In [Part 1](#) of this series, we explained that flows through crude and refined product pipelines operate within a “turbulent flow regime” in which fluid molecules move in a random manner, and where some of the energy applied to them by pumps and/or downhill gradients is wasted. Reducing that turbulence—and the “frictional pressure drop” or “drag” that it creates—is the aim of DRAs. To understand how DRAs work, you need to know that the turbulent flow regime has three parts: 1) a “turbulent core” that takes up most of the pipe's internal diameter and accounts for the vast majority of the fluid flowing through the pipeline, 2) a “laminar sub-layer” along the pipe wall, and 3) a “buffer zone” between the turbulent core and the laminar sub-layer. Without DRAs, the flow along the pipe wall is in lateral sheets, slivers or “streaks” of which constantly slough off through the buffer zone into the turbulent core, making the flows more random, raucous and energy-wasting.

DRAs are ultra-high molecular-weight, long-chain polymers (think flexible strands of spaghetti at a molecular level) that are injected into pipelines just downstream of pumping stations. Once there, these “wet noodles” flow downstream and act like shock absorbers as they “catch” the streaks as they slough off the pipe wall and thereby minimize the turbulence the streaks would otherwise have created. Long story short, by reducing the turbulence within the pipe, DRAs ease the flow of crude or refined products through the pipeline, which increases the volume of fluid that can move through the pipe within any given period of time with the same amount of energy (i.e. pump horsepower) applied to the system.

There are four basic ways that a midstream company might apply the benefits of DRAs:

- To increase the capacity or throughput of a pipeline from end to end; DRAs have the potential to more than double pipeline throughput.

- To remove constraints or bottlenecks within a specific portion (or portions) of a pipeline.
- To reduce the operational pressure (or need for pumping) within a pipeline; this cuts energy costs (for pumping) without reducing throughput.
- To allow throughput volumes to be maintained in the event the pipeline operator is compelled to reduce the pressure in a pipeline (maybe because it's old or has been damaged).

(A few other things to remember about DRAs—they are injected in very small volumes (typically measured in parts per million, or PPM); they don't change the chemical composition, density or viscosity of the crude oil or refined products they flow with; and the long, spaghetti-like strands of DRA take a beating and gradually break apart as they flow downstream, so a new injection of DRAs is needed after each pumping station.)

Figure 1 shows the impact of DRA treatment on pipeline pressure as a function of throughput. As the flow rate (x axis) increases, the frictional pressure drop (y axis) also rises. The red line shows that without the use of DRAs, the frictional pressure drop (and the turbulence) begins to increase exponentially, causing pipeline pressures to rapidly approach maximum safe operating conditions. When DRAs are injected, though (yellow line), the frictional pressure drop (and the turbulence) increase at a much slower rate.

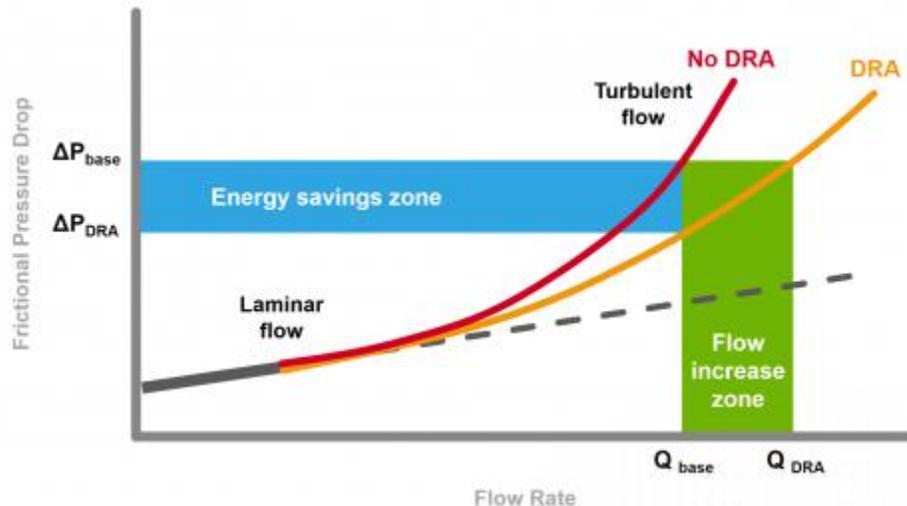


Figure 1; Source: LiquidPower Specialty Products Inc.

Sticking with Figure 1, let's assume that the targeted operating pressure is the upper edge of the blue shaded area ("P base"). Using DRAs would allow a pipeline operator to increase the flow rate on the pipe from "Q base" to "Q DRA"—that is, the width of the green shaded area ("flow increase zone") with no change in the operating pressure. Another option would be using DRAs to reduce the pressure in the pipe from "P base" to "P DRA"—or the height of the blue shaded area ("energy saving zone")—either because the operator needed to reduce the pressure for safety reasons or because the operator wanted to reduce its pumping/energy costs. Note that by using DRAs, the operator could reduce the pipe's pressure without reducing flows through the pipe.

DRAs are all about reducing turbulence—so the more turbulence, the more DRAs can accomplish in increasing throughput and/or reducing pipeline pressure—and the pipes that have the most turbulence are generally those that transport low-viscosity/easy-flowing refined products (like motor gasoline and diesel) or lighter crudes such as condensate, West Texas Intermediate (WTI) or Light Louisiana Sweet (LLS). As a result, the vast majority of DRAs are injected into pipelines that carry refined products and lighter crudes (those with API gravities of 25 degrees or more). In recent years, though, at least a few companies in the DRA space (Berkshire Hathaway's LiquidPower Specialty Products being the most widely known) have developed DRAs specifically for heavier, higher-

viscosity crude and blends such as “diluted bitumen” (dilbit; see [Heat It](#) for more on dilbit), or Mexican Maya.

DRAs’ position in the market has really evolved over time. When flow improvers were first being developed in the 1970s and ‘80s (and for years after that) DRAs were seen almost exclusively as problem solvers (to make up for a failed pumping station or to eliminate a bottleneck, for instance). More recently, though—and increasingly, now—the use of DRAs is being integrated into the planning of new pipelines, expansions, conversions and reversals. A prime example was the just-completed Energy Transfer Crude Oil Pipeline (ETCOP) from the southeastern terminus of DAPL in Patoka, IL to Sunoco Logistics Partners’ (SXL) terminaling facilities in Nederland, TX. ETCOP—which involved the conversion and reversal of a 30-inch-diameter natural gas pipeline (once part of the Trunkline system), plus 66 miles of new connecting pipe—originally was planned to have 14 pumping stations but reportedly ended up needing only four, thanks in part to the expanded use of DRAs. (Pumping stations can cost tens of millions of dollars a pop, so that’s quite a capex saving.)

Another example of the now-routine use of DRAs in midstream development is a proposed 115-Mb/d expansion of the 230-Mb/d Ozark Pipeline, which transports crude from the Cushing, OK hub to Wood River, IL. In December 2016, when Enbridge launched a binding open season to affirm shipper interest in the project, it said the new capacity would be made available through a combination of DRA use and added horsepower at pumping stations along the pipeline’s route. (In mid-February 2017, MPLX reached an agreement to buy the Ozark Pipeline, and filed a petition at the Federal Energy Regulatory Commission—or FERC—for permission to undertake the Ozark expansion.)

The Ozark project, scheduled for completion in the second quarter of 2018, is just the tip of the iceberg. DRAs now are showing up time and again in FERC applications for new and expanded pipes. With DRAs adding incremental barrels to light crude and refined product pipelines at minimal incremental cost, and with producers and shippers still commitment-phobic, drag reducing agents are likely to solidify their already-important role in the midstream sector.

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“Kind of a Drag” was a 1967 hit for The Buckingham and the title of the Chicago-based pop group’s debut album.

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