SPILL RESPONSE & ALTERNATIVE RESPONSE TECHNOLOGIES BY JOHN BRINKMAN

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Note from Editor: The editorial policy of the ISCO Newsletter does not normally allow the use of trade names in contributed articles and such articles should be free of product promotional content. However, in this case, an exception has been made. Because the product described is a single-source one-of-a-kind it was not practical to avoid use of the brand name

The article is a follow-up to the discussion on defining sorbents and adsorbents arising from Mark Francis' article on Shoreline Clean-up in issue 538 of the ISCO Newsletter and the ensuing correspondence in issues 539 and 540.

Part 1 - Adsorbents versus Absorbents (Imbiber Beads®)

Several weeks ago I provided information concerning the differences in performance between adsorbents and absorbents in order to try and clarify the confusion that seems to reign within the global oil spill response industry.

ASTM is pretty specific as to what the prefix "ad" implies and what the prefix "ab" implies when used with the word sorbent. The definitions are specific with respect to the performance and eliminate the subjective nature described in Mark Francis' article.

Dr Merv Fingas is correct with his comment that the "spill response" industry for the most part does not make the distinction either because it is not considered important or that it is not aware that a fundamental difference exists in the performance? (Conversely, the air emissions industry makes the distinction because it is in that particular industry's best interest to be able to purge and remove contaminants from the adsorbing material as part of the filtration process).

Similarly, in the water filtration industry where the removal of contaminants from activated carbon filters is advantageous the industry uses the term adsorption when referring to the performance. It seems that only the spill response industry continues to obfuscate the meaning and terminology?
With respect to Mark Francis' comments concerning the response industry having it wrong, "yes" that is the case; ASTM is a voluntary consensus standards group comprised of industry experts and for years Dr. Fingas sat on the committee that actually compiled the standards and definitions referenced. Both ASTM F-716 and ASTM F-716 reference that the solid sorbent material must "swell" at least 50% in order to be classified as an absorbent.

The confusion surrounding the performance between adsorbents and absorbents has caused Imbibitive Technologies (IMBTEC) to have to refer to Imbiber Beads® as a "super-absorbent" polymer when the reality is that we manufacture an "oil-sensitive", absorbent polymer in accordance with ASTM definitions.

Similarly, when Victor Mills (Procter & Gamble) invented the first "water-sensitive" absorbent polymer he referred to it as a super-absorbent polymer because there are a number of cellulosic materials that absorb water, such as cotton for example, and will swell in the presence of water.
This is why cotton fibers are used in bath towels. The distinction of "super-absorbent" implied that the polyacrylates and polyacrylamides used in disposable baby diapers/nappies will absorb many, many volumes of water in comparison to cotton cloth diapers.
The fact that you will locate bags of mineral sorbent products such as perlite, vermiculite or clay granules incorrectly labeled as "absorbents" is testimony to the confusion that reigns within the industry. When was the last time you saw a clay granule "swell" in gasoline/petrol? (Bentonite clay will "swell" in the presence of water but not in the presence of hydrocarbons).

I am not aware of any polypropylene sorbent products where the fibers "swell" 50% nor am I aware of any polypropylene products that do not leak their contents with simple gravitational pull or will leach an amount of their

contents in a current in excess of 1 or 2 knots. Studies have demonstrated repeatedly that the adsorbent materials used by the response industry and industry-at-large cannot pick-up more than once their own volume of spilled liquid; in many instances several volumes of adsorbent are required for every volume of liquid spilled. It is because of this that sorption capacities for adsorbents are measured by "weight" as opposed to by "volume".

Since polypropylene adsorbents are "lightweight" the numbers used are not very meaningful i.e. even fifty times the weight of a feather is not very much product?

This implies a number of logistical issues when it comes to storage, transportation and disposal of significant volumes of adsorbent products due to their inefficiencies. In many instances the use of adsorbents is more cosmetic than effective, especially when low viscosity liquids such as fuels and solvents are involved. Response contractors will often "deal" sorbent pads like playing cards onto a spill in the hope they will pick some of the released liquid up; not a very effective way of cleaning up spills and costly.

Being the only product of its kind has been problematic for Imbiber Beads® because the tendency is to lump them into the broad category of all too similar adsorbent products. This is unfortunate for the response industry because Imbiber Beads® use on organic liquid spills brings a number of positive attributes to the equation even as a "front-line" spill response tool.

With respect to the "heavy oils" referred to by Mark and Merv, IMBTEC does not profess that these are the strength of Imbiber Beads® nor do we claim that use of Imbiber Beads® is the answer for every spill response or environmental incident but that was not the point of the discussion. The point of the discussion was to provide technically accurate information to the ISCO readership regarding the definitions and expected performance for adsorbents and absorbents.

Part 2 – Alternative Spill Response Technology

In his response to my comments concerning Mark Francis' reference to sorbent products within his series of articles, Dr. Merv Fingas took it upon himself to make the following comment:

"The only absorbent product out there is the Imbiber Beads® - but no one should use them externally - that is uncontained such as on a beach - how would you ever pick them up which one should do - further when used on anything heavier than Naphtha the process is again adsorption - heavy oil does not enter into the imbiber bead"

I did not raise the issue of where Imbiber Beads® are best used or the types of spilled products they work best on nor did I reference any particular application, but feel it necessary to correct several of the assumptions associated with Dr. Fingas' comment.

Imbiber Beads® work very well on "fuels and solvents" and the capture and containment of the spilled liquid is absolute; meaning that once imbibed/absorbed they cannot be re-released back into the environment or onto response personnel; thereby eliminating secondary contamination (a problem inherent with adsorbents).

US EPA references this in their Code of Federal Regulations that **"liquids imbibed are no longer available for release as liquids". (40 CFR pts 260, 261 et al)**

Further to this, Imbiber Beads® work very well on a range of crude oils, including but not limited to Alyeska North Slope (Exxon Valdez – March 1989), Sweet Louisiana (Macondo/DWH – April 2010), most Arabian crude oil, Sweet Alberta, Bakken, Diluted Bitumen, to name a few. Imbiber Beads® work best when the "lights fraction" is still available, which typically is in the early stages of a spill event, and will transform crude oil into a non-sticky, semi-solid mass that can be recovered off of water using existing skimmer technologies.
The topic of how best to deal with released Bakken crude oil and/or Diluted Bitumen due to its' higher aromatic content is front and center due to several recent train derailments and pipeline expansions.

Tests have demonstrated the ability of Imbiber Beads® to reduce (not eliminate) the "rate" at which hazardous vapours are released by eliminating the liquid phase and transforming the spilled liquid into a semi-solid. This reduction in the rate of off-gassing lowers the concentration-in-air to below LEL in many instances; thereby making the spill site safer for response personnel.

Note: Conversely, commonly used adsorbent products such as those referenced above rely upon increased exposed "surface area" and actually enhance the rate of vapour release, which increases the concentration-in-air and

dramatically increases the risk to response personnel by lowering the flashpoint and increasing the explosion and fire hazard. Why would anyone knowingly put their response personnel at risk by using these sorts of materials?

As has been demonstrated by the contents of this dialogue most people, even those who have spent the better part of their career in spill response are not aware of the fundamental difference in performance between "adsorbents" and "absorbents" and what that performance implies.

Similarly, using vapour-suppressing foams addresses the explosive vapour issue as long as the foam layer remains undisturbed but the spilled liquid still needs to be picked-up. (Imbiber Beads® facilitates both.)

For the past forty years or more the global oil spill response industry has relied upon the same oil spill recovery technology and not surprisingly has recorded the same oil spill recovery statistics of 10 – 15%, in spite of what may be the best intentions, and having spent billions of dollars on equipment, training exercises, sensing devices, modelling software, surveillance equipment, etc.
That so much attention is dedicated to shore-line clean-up is testimony of just how ineffective the current range of technologies is during response operations.

Invariably response operations become shore-line clean-up operations because the release quickly reaches "unmanageable proportions" within hours of the incident occurring; an issue raised by the US Office of Technology Assessment (US OTA) in their report to the US Congress ("Coping with an Oiled Sea") in March 1990, one-year after the Exxon Valdez.

OTA referenced that an oil spill will spread six (6) square miles within the first twelve hours with little wind or current assistance.

Meanwhile as the slick continues to spread and head off in a myriad of rivulets it also continues to "thin"; thereby rendering most skimmer equipment unable to meet its rated skimming capacity, which further compounds the logistical problems.

On the issue of oil spill cleanup effectiveness a paper entitled **"Factors that Determine the Costs of Oil Spills"** presented at the 2003 edition of the International Oil Spill Conference by representatives of the International Tanker Owners Pollution Federation (ITOPF - London, UK) states:

"An active response is therefore often adopted even when technical opinion is agreed that it is unlikely to have a significant benefit. This is usually due to the fact that oil spilled on the surface of the sea spreads rapidly, thereby extending over an area that is too great to be countered effectively by available techniques. Added to this are the limitations on containment and collection systems imposed by winds, waves and currents and the severely reduced effectiveness of chemical dispersants on high viscosity oils and water-in-oil emulsions (mousse). Responding in such circumstances can lead to high cleanup costs for little or no benefit in terms of mitigating the oil's impact on coastlines and sensitive resources".

The ITOPF reference from 2003 has even more relevance when considering the US Oil Spill Commission's report to the President in January 2011, one-year after the Macondo/DWH catastrophe when it states that of the 44,000 personnel and 6,000 skimmers involved in the operation only 3% of the 200-million gallons of released oil was recovered at an operational cost of US $7.5 Billion to BP. (This does not take into account the fines and lawsuits BP has faced since the incident). Even if BP actually recovered 10% of the oil it still reflects the lack of improvement of oil spill recovery technologies over the past fifty years, no matter what the circumstances are and how extenuating.
To address the issue of being able to respond to an oil slick in the shortest possible time the oil industry is promoting the concept of ever-increasing acceptance of disposal technologies such as dispersants and in-situ burning.
In the case of dispersant use it allows for the dispersant to be aerially applied within hours of notification instead of the days it currently takes to mobilize and transport significant amounts of mechanical recovery equipment and personnel to the spill site. In many instances however, dispersant use and in-situ burning will not be an acceptable alternative, which means that a heavy reliance will remain upon mechanical recovery and the meager recovery results of the past fifty years, unless new ideas and concepts are adopted.

Part 3 – Fast-Attack Spill Response

Setting aside the objection by Merv Fingas for the use of Imbiber Beads® on "heavy oils" and focusing instead upon the oils Imbiber Beads® work well on, the concern raised by Dr. Fingas is "how to collect Imbiber Beads® and/or the imbibed oil"?

NOTE: Rather than considering the use of Imbiber Beads® for the purpose described the immediate reaction (bias) is to dismiss their use because of a perceived problem that may not exist?

In order to overcome an obstacle the key to is to identify the problem and then work on a solution.

The global spill response industry has in effect addressed the issue of oil spills reaching unmanageable proportions by advocating the increased use of dispersant as a "fast-attack" response technology.

Accordingly, there are a set of obstacles for mounting a successful "mechanical" oil spill response operation and improving oil recovery statistics.

(1) – In spite of best intentions and wonderful planning exercises it still takes too long to mobilize and get to the spill site.
(2) – While the spill operation is mobilizing and steaming to the spill site the slick continues to spread and reach unmanageable proportions.
(3) – By the time the response operation arrives on-site the slick has thinned to the point where skimmers are ineffective.
(4) – Failing to recover significant volumes of spilled oil during the initial phase of the response operation the oil begins coming ashore.
(5) – Once the cause of the release is stopped the response operation turns into a shoreline clean-up operation.
(6) – As a result of an ineffective spill response operation the local environment is impacted; often for years.

So the question needs to be **"how can the response industry keep an oil slick from spreading to unmanageable proportions and buy time for the response operation to mobilize and arrive at the spill site**"?

(1) Believe it or not the concept of using Imbiber Beads® on an oil spill was first proposed by Dr. Richard Hall, formerly of The Dow Chemical Company, in 1970! What Dr. Hall proposed was to deliver Imbiber Beads® onto a spill using aerial delivery, which addresses the issue of being able to respond in a timelier manner and get to the spill site within hours of notification.

(2) Dr. Hall stated that when Imbiber Beads® come into contact with organic liquids such as crude oil they begin to soften as the oil diffuses into their solid structure, and they begin to "swell". He also went on to explain that as the swelling is occurring Imbiber Beads® transition to a "sticky" state, which assists in the agglomeration of the "imbibed" crude oil into a semi-solid mass or "chunks" of imbibed oil.

(3) The agglomeration of the oil addresses the issue of preventing the oil from spreading to unmanageable proportions; thereby helping to keep the slick together, which in turn facilitates more effective use of recovery equipment such as skimmers.

Application of Imbiber Beads® in the early stages of the response operation transforms the oil into semi-solid chunks of oil and prevents the oil from becoming emulsified and more difficult to handle.

(4) Application of Imbiber Beads® eliminates the liquid phase and transforms the oil into a non-sticking, semi-solid that can be recovered off of the surface of the water in chunks using existing recovery techniques. As a semi-solid material it is no longer in a liquid state and as a result can no longer coat marine life, or wildlife or shorelines, flora or fauna.

(5) In the event some of the imbibed oil were to come ashore it can literally be picked up "by hand"; taken to a refinery and thermally processed and recycled; thereby **"closing the environmental loop".**

(6) More effective oil recovery means less damage to the environment and less impact upon local economies.

For your information, the oil industry/response industry responded to Dr. Hall's proposal by declaring that it would be 'too expensive" a proposition in comparison to "tried and true" spill response techniques; techniques that to this day forty-six years after Dr. Hall made his proposal continues to average only 10 – 15% spilled oil recovery. (How can this continue to be justified?)

Taking the price objection, with consideration of the historical facts, the "value" of the current array of techniques and equipment used reflects the following:

(1) **Exxon Valdez (March 1989)** – oil recovered = 6% of 11-million gallons (660K gallons) @ $2.5 Billion (response operation only) = about **$3,800.00** per gallon recovered.

(2) **Macondo (April 2010)** – oil recovered = 3% of 200-million gallons (6M gallons) @ $7.5 Billion (response operation only) = **$1,250.00** per gallon recovered.
With the fines/lawsuits assessed to BP the cost per gallon recovered comes in at **over $4000.00** per gallon.

By comparison, the cost to treat a gallon of crude oil with Imbiber Beads® is **$10/gallon**. Even if equipment and ancillary costs are factored in and a 50Xs multiple is used it is still a far cry from the costs associated above and the recovery statistics have a much greater chance of improving versus continuing to do the same things over and over again from the past fifty years and expecting different results.

Albert Einstein is credited as this being the definition of "insanity".

The bottom line in this case, (all things considered), is that all 200-million gallons of oil released during Macondo could have been treated with bulk particulate Imbiber Beads®, skimmed from the water and recycled for a cost of approx. US $2 – 3 Billion; the assumption being that strategic stockpiles and ancillary equipment were in place.

Part 4 – Alternative Response Technologies & OSROs

Taking into account the objection perceived by Merv Fingas that recovering imbibed oil would be problematic to the response operation IMBTEC has determined that each Imbiber Beads® "blanket" will capture and contain 2-gallons of crude oil. At an average cost of $40 – 50 per blanket this translates into a cost per gallon of only $20 – 25, and since the absorption is absolute (meaning there is no longer oil available for re-release to the environment) there is no need for skimmer equipment; the blankets can be recovered from the water using something as simple as boat hooks or fishing nets.

ITOPF's paper of 2003 makes reference that certain variables must be taken into account in order to determine the most effective means of dealing with an oil spill. The type of oil; the location of the spill, weather conditions, sea state are but a few of the items that require consideration.

The spill response industry has identified all of these conditions over the past fifty years and has failed to come up with any appreciable measures to counteract them, and as a result the status quo remains at 10 – 15% recovery statistics, which implies that this is "good enough"?

Dr. Fingas's comment that no one should consider using Imbiber Beads® on a catastrophic oil spill because it would be difficult to retrieve them is in my opinion indicative of an entire industry that has been allowed to sustain itself with mediocrity and continues to be "enabled" by government agencies unwilling to hold the oil industry/response industry to a higher level of accountability.

Case in point, in spite of approaching all of the major OSROs around the world over the past twenty-years of my involvement with Imbibitive Technologies, not one of them has stepped up to offer to run trials that would demonstrate and ultimately prove (or disprove) Dr. Hall's proposal.

The reason why none of them has stepped forward in my opinion is really quite simple. They do not have to improve their performance because there is no "**measurable performance criteria"** in any of the regulations for actually having to remove oil from the environment. OSROs and their response contractors are compensated regardless of their performance and it does not matter if they remove 10% of the oil from the environment or only 3% of the oil; they are still entitled to reimbursement and compensation.

The very considerations listed above are used as excuses for their poor performance, instead of looking for solutions.

Accordingly, IMBTEC has addressed these issues and developed a multi-component, state-of-the-art, fast-attack spill response system we refer to as **HEROS® Treat & Skim™ System**. HEROS® Treat & Skim™ System addresses the items referenced as holding back progress in improving oil spill recovery statistics.

Is it the answer to every spill scenario; absolutely not, such a system does not exist, but at least it provides a mechanism for recovering significant volumes of spilled oil instead of simply disposing of it through the use of dispersants or in-situ burning or allowing it to soil miles and miles of shoreline.

Some of the other myths propagated by the response industry are that "certification" of an OSRO guarantees a level of excellence.

In an article written for the July 2014 edition of **Maritime Reporter & Engineering News** by Dennis Bryant, former USCG Chief of Regulatory Development he admits that the OSRO guidelines proposed by the USCG committee he sat on were completely voluntary on the part of the OSRO, were outside the USCG's legal jurisdiction and have nothing to do with the Oil Pollution Act of 1990.

Mr Bryant further intimates that he and his colleagues were more or less "flying by the seat of their pants" in trying to draft meaningful regulations for oil spill response companies that the USCG had no jurisdiction over.

The guidelines further note that while classification provides a good indication of an OSRO's response capability, simply being a Coast Guard-classified OSRO does not guarantee performance during an actual spill. In this regard it should be remembered that the response plan regulations also include the following caveat: **"The specific criteria for response resources and their arrival times are not performance standards. They are planning criteria based on a set of assumptions that may not exist during an actual oil spill incident."**

Taken from **"Guidelines for the U.S. Coast Guard Oil Spill Removal Organization Classification Program"** (24 April 2013 as CG-MER Policy Letter 03-13):

An OSRO is subject to periodic examination to maintain its classification status. In addition to periodic examinations to maintain classification status, verifications may also occur. The basis for verifications might include:

a. Unsatisfactory verification visit.
b. COTP request.
c. OSRO's poor performance during spill or exercises.
d. OSRO request.
e. Change in ownership.

So what measurable performance criteria are being used to evaluate a OSROs performance during an oil spill? During meetings with US EPA last year, it was disclosed that while the intention is to recover 100% of any spill; 25% would be considered a job well done. So what is the penalty if the OSRO fails to recover 25%?

My impression from reading some of the background concerning the development of OPA '90 and the early guidelines for OSROs was that everyone had only the best intentions and the goal was to provide state-of-the-art spill response equipment and tactics in order to minimize the sort of damage witnessed during the Valdez. Accordingly, the emphasis should be on oil spill "removal" organizations, not simply on organizations that can only "respond", yet at least on the surface this is exactly what has happened?

April 2013 - The Revised OSRO Guidelines: "OSRO classification is not intended to represent a certification, but to reflect an approximation of capability. This capability requires validation from industry plan holders and the government to ensure that OSRO capabilities are able to meet specific response needs. OSRO Guidelines and the OSRO Classification Program represent a starting point for evaluation of an OSRO".

All of the language has transitioned from an OSRO being an oil spill **"removal"** organization to being an oil spill "**response"** organization; picking up the telephone is tantamount to a "response".

Similarly, to continue to refer to an OSRO's "capability" as opposed to its' "ability" to remove oil is in my opinion part of the problem.

For the record, we are aware that OSROs have their own set of challenges when it comes to spill mitigation and running a business. This is not an anti-OSRO letter; it is a letter against the status quo that has remained in place over the past twenty-six years or more.

The oil & gas industry is experiencing a significant amount of "push-back" from environmental and special interest groups because the perception within the public domain is that the global spill response industry is not very good at cleaning up oil spills. Based upon recovery statistics over the past twenty-six years their concerns are well-founded.

In my opinion the global spill response industry needs to "up its' game" and look for ways to improve its performance.
