

PRODUCT COMPLIANCE WITH THE ANGOLAN MINISTRY OF PETROLEUM'S NEW DISCHARGE DECREE

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Abstract

The environmental performance of a product can be evaluated according to criteria such as ecotoxicity, biodegradation, and bioaccumulation. The country of Angola has announced new regulations governing discharges from petroleum operations, and this includes requirements for product approval.

There are two core regulatory schemes commonly applied to selecting products suitable for discharge in the petroleum industry. The "up-front" testing of individual substances in products has historically been a North Sea approach, while the "end-of-pipe" testing of whole effluents is a Gulf of Mexico approach. The "up-front" scheme applies a larger range of tests to each individual component of a product to determine the ecological risk, while the "end-of-pipe" scheme focuses on the ecotoxicity of the whole effluent discharge to take into consideration any synergistic effects.

Angola based their new rules on the "up-front" product testing approach, at least in part, due to the lack of infrastructure required for "end-of-pipe" testing in Angola. The regulatory agency establishing the new rules is the Ministry of Petroleum. The regulatory document, Executive Decree 244/12, is in its infancy; it is brief and lacks certain details. Ecotoxicity test methods and organisms were not specified, nor were requirements for different types of products. In addition, atypical methods and approval criteria were outlined for the testing of inorganic substances.

Clear regulatory criteria are essential for product evaluation and further clarification is required from Angola. These issues will be discussed within the context of steps that an industry must take to meet changing regulatory requirements.

Introduction

Angola is a country on the western coast of Sub-Saharan Africa. Executive Decree 244/12 was released in July of 2012 for the regulation of discharge operations. The effective date rapidly approaches in January 2014. The objective for our environmental and operational personnel is to smoothly transition into the new regulatory system without disruption in the performance of products used to drill. Experience with the implementation of new requirements highlights the importance of understanding the full context of regulatory controls. Expertise, guidelines, and infrastructure are required to support test result-based regulatory requirements.

Globally, the discharges associated with drilling fluids from operations in the oil and gas industry are regulated by two core regulatory schemes. The Gulf of Mexico scheme is widely followed in the Western Hemisphere while the North Sea scheme is widely followed in the Eastern Hemisphere. They have different test methods and they vary in the time of testing.

- Gulf of Mexico**
- Regulated by the U.S. Environmental Protection Agency
 - Some product certification prior to use
 - Effluents tested at time of discharge
 - Favors local testing labs

Up-front

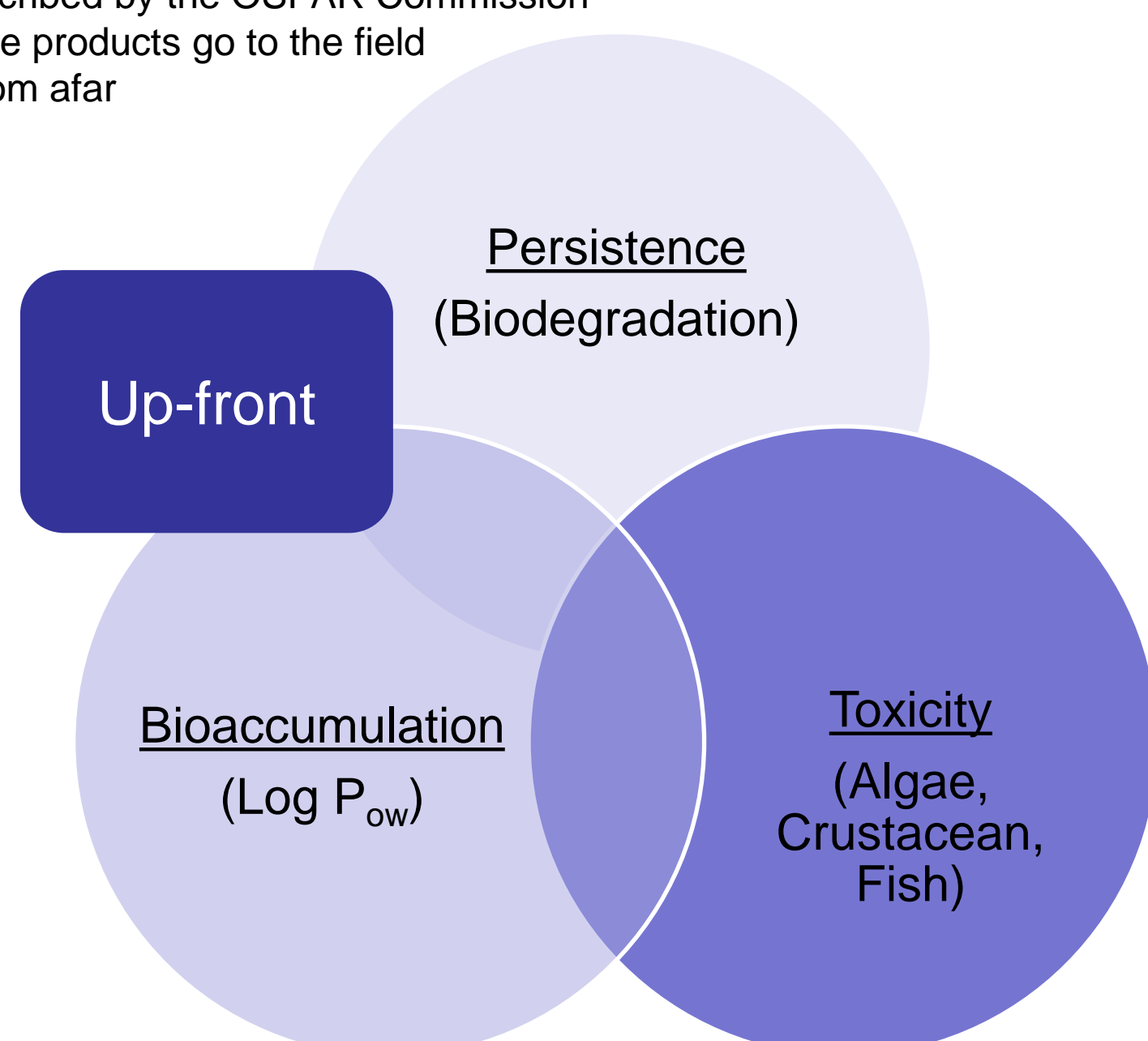
- Multiple test approaches for large volume products

End-of-Pipe

- Focus on toxicity and free oil

North Sea

- Core requirements described by the OSPAR Commission
- Chemical testing before products go to the field
- Testing can be done from afar



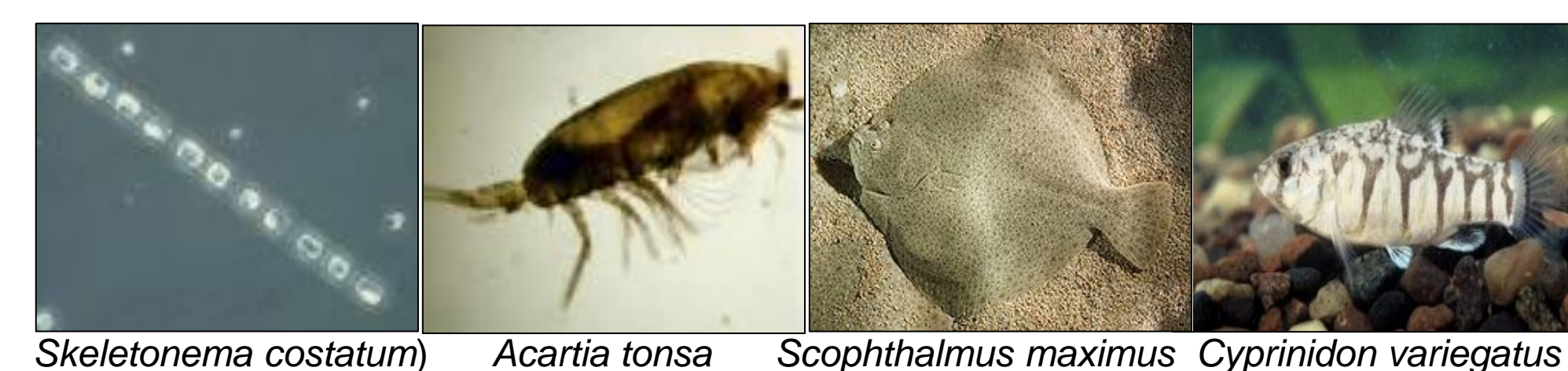
The local infrastructure in Angola does not support end-of-pipe testing because they lack the local testing laboratories. A North Sea-like regulatory structure was chosen by the Ministry of Petroleum for Angola.

Methods

Products: Drilling services products currently used in offshore operations in Angola, including products such as weighting agents, emulsifiers, lubricants, corrosion inhibitors, and defoamers. They represent an assortment of different formulations that were designed to meet drilling and environmental requirements. Additional replacement products were also added to comply with the new regulations.

Environmental Tests: Test results were acquired from the M-I SWACO Global Toxicity Database. These test results follow the procedures outlined by the OSPAR Commission^{6,7}. Tests were conducted in M-I SWACO's GLP lab in Bergen, Norway, or provided by our vendors. Briefly, these methods include:

- Aquatic toxicity** with algal growth (EC₅₀) and crustacean and fish mortality (LC₅₀)



- Biodegradation** with 28 day aerobic tests (OECD 301 and 306)

Persistence is measured by biodegradation. A suite of methods are described by the Organization for Economic Co-operation and Development (OECD). OECD guidelines 301 A-F are 28-day aerobic tests, and method OECD 306 is a saltwater variation^{3,5}.

- Bioaccumulation** with log P_{ow} (OECD 107)

Bioaccumulation is predicted for organic chemicals via octanol-water partitioning coefficient (P_{ow}) and molecular weight (MW).

Analysis of Products: Products were evaluated based on substance-level (chemical ingredient) data according to the modified requirements in Table 1. Initially the compliance criteria came from Article 6 of the Angolan Executive Decree 244/12¹. However, a modified set of criteria has been adopted based on a review of North Sea requirements from the OSPAR Commission^{6,7} and later discussions with representatives from the Angolan Ministry of Petroleum.

Results & Discussion

Review of Regulations

The Angolan regulations are a new application of North Sea test protocols and the Angolan Government does not currently have certain infrastructure and implementation tools that are in place for the North Sea. Examples of infrastructure and implementation tools available in the North Sea region that are not available in Angola include the following:

- Exemption from testing PLONOR substances
- Instructions for estimating difficult test substances (Ex: P_{ow} and surfactants)
- Justification procedures for products lacking suitable replacements
- Product certification agencies (Cefas)

The OSPAR commission provides further instruction on all of the above. Representatives from the Angolan Ministry of Petroleum have indicated that when in doubt they wish to defer to actions that would be allowable in the North Sea. However, they have not yet put in all the infrastructure and implementation tools that are available in the North Sea region which constrains the available products and increases the stress of implementing the new requirements.

Some criteria in Decree 224/12 were confusing so a meeting was held with the Ministry of Petroleum. Outreach was conducted. For example, bioaccumulation is of concern when a molecule is hydrophobic and small in size; large molecules are not bioavailable and do not typically achieve their bioaccumulative potential. Representatives of the Ministry of Petroleum expressed that they intended to follow the North Sea criteria (Log P_{ow} ≤ 3 or MW > 700) and the requirements should be changed. It was also discussed to group the biodegradability criteria, and both of these modifications are represented in Table 1. These issues were clarified in a meeting but the official rules have yet to be changed resulting in continued confusion and additional stress of implementing the new requirements.

Additional discussions are required to address other criteria. For example, their request for bioaccumulation data on inorganic substances. P_{ow} and MW are common estimation methods for organic substances, but not for inorganic substances². This data has not been requested in the North Sea, is not available for review, and therefore has been eliminated under the modified criteria in Table 1.

Table 1. Product Compliance Criteria

	From Executive Decree 244/12	*Modified Criteria
Organic Substances (must meet 2 requirements)	1) Biodegradability > 70% with OECD 301 A & E 2) Biodegradability > 60% with OECD 301 B,C,F or 306 3) LC ₅₀ or EC ₅₀ > 10mg/L 4) Log P _{ow} ≤ 3 or MW < 700	1) Biodegradability > 70% with OECD 301 A & E OR Biodegradability > 60% with OECD 301 B,C,F or 306 2) LC ₅₀ or EC ₅₀ > 10mg/L using OSPAR pre-screening test methods 3) Log P _{ow} ≤ 3 or MW > 700
Inorganic Substances (must meet all requirements)	1) Log P _{ow} ≤ 5 or MW < 700 2) LC ₅₀ or EC ₅₀ > 1mg/L	1) LC ₅₀ or EC ₅₀ > 1mg/L using OSPAR pre-screening test methods

*These criteria are based on communications with representatives from the Angolan Ministry of Petroleum and comparison with North Sea requirements.

Product Compliance

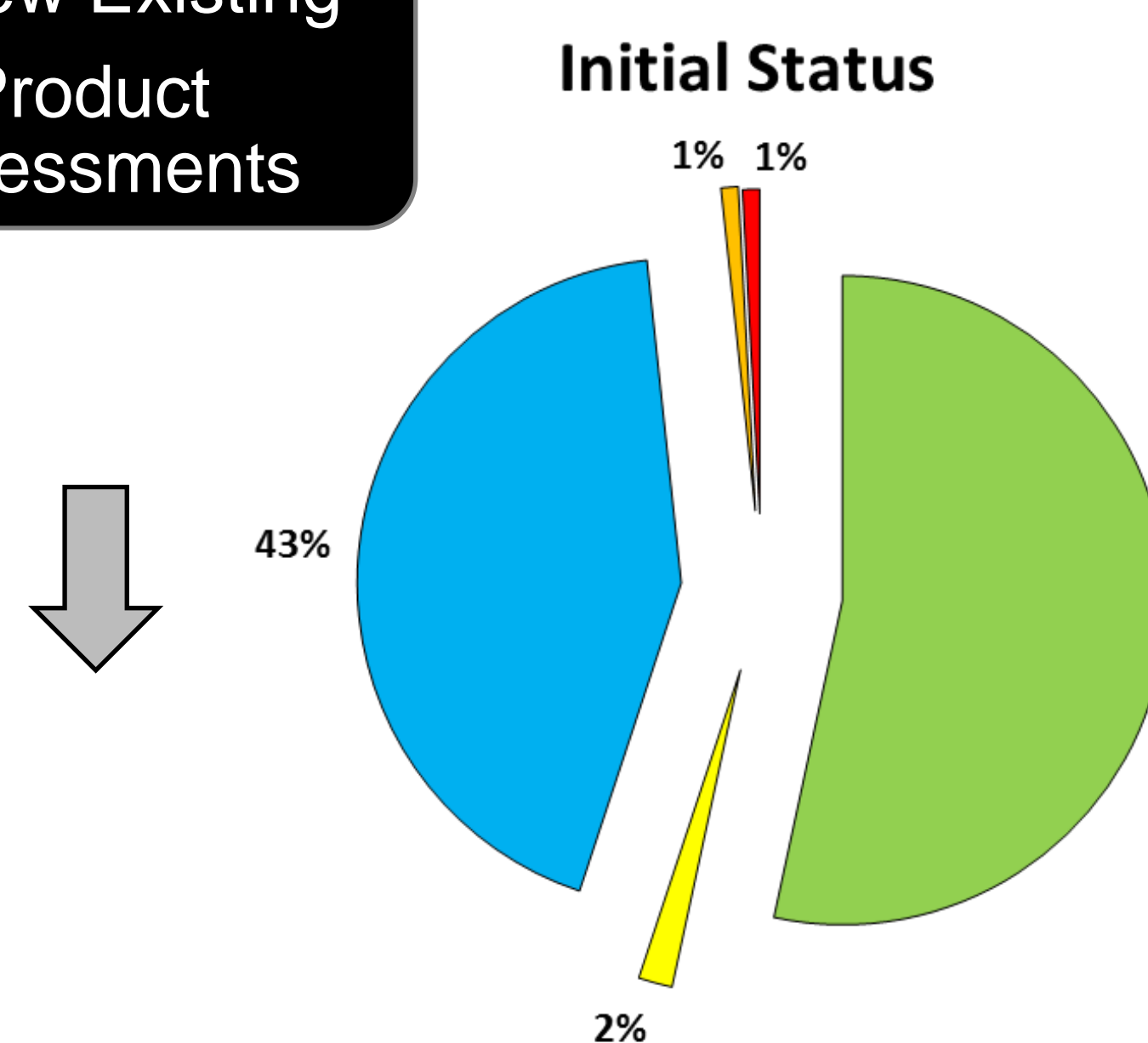
Prior to the new requirements, some of the products used in Angola were designed for compliance with the GOM rules and some of the products were designed to meet North Sea rules. In order for any product to be used after the new rules are implemented they must be documented to meet the new rules. Test data must be reported for all products, but only discharged ones must pass. Products that were not compliant were further characterized as not discharged, qualifying for justification, or not compliant (Figure 1). Compliant products were defined by the modified criteria (Table 1). It is important to recognize that some products allowed for use in the North Sea and others allowed for discharge in the GOM will not be allowed for discharge in the new rules in Angola.

As an example of the work flow to meet the new requirements, an initial 118 initial products were evaluated, 67 of them had been previously reviewed for use in the North Sea, and had readily available substance-level testing results organized into product assessments. However, 43% of our products required additional research and review (Figure 1).

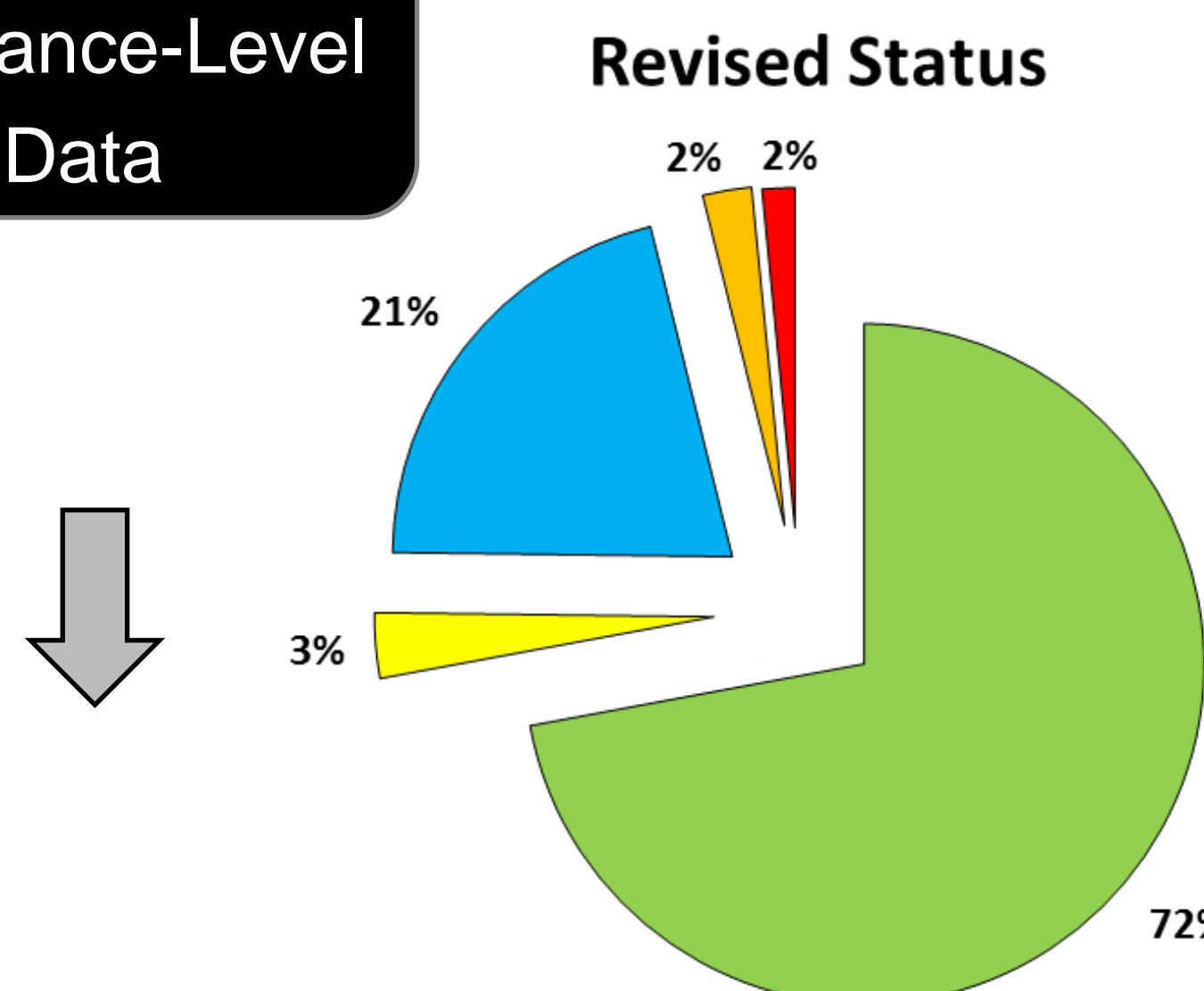
Recall that the products are not tested, but rather the substances in them. Therefore a more complete data set could be obtained by reviewing test data for substances in the remaining products. When products were not compliant, 11 additional products were identified for review. This second round of review with substance-level data allowed us to characterize an additional 35 products.

Product testing takes up to one month and it can take several months to acquire the specific chemicals for testing. Only a limited amount of additional product characterization will be possible before January 2014, resulting in additional stress to meet the new rules and continue to provide the range of products necessary for efficient drilling operations.

Review Existing Product Assessments



Review Substance-Level Data



Conduct Additional Testing

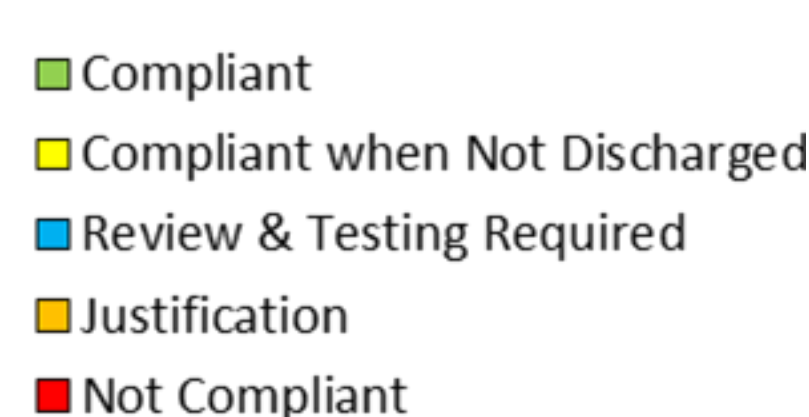


Figure 1. Steps of Product Compliance Review

Conclusions

The new regulations in Angola will bring a wide variety of environmental evaluation and mitigation strategies, ranging from environmental monitoring to waste management to product use. While complying with the new regulations, some of the challenges that the industry is facing include meeting timeframes for product testing, building waste management facilities, and phasing out non-compliant inventory.

There are specific challenges for the testing and evaluation of products. The current regulatory document contains language that is inconsistent with scientific knowledge. The criteria for molecular weight specifies that only bioaccumulative products should be used. The test requirements for the bioaccumulation of inorganic substances go against general knowledge and are impractical to conduct.

Preliminary discussions about these concerns have begun, however it is not clear if all parties in the industry are aware of these details. For this reason, it is critical to obtain formal clarification from the Angolan Ministry of Petroleum on these essential product testing and evaluation criteria.

At the moment efforts to provide product compliance data to operators in the context of the modified criteria in Table 1 continue, along with outreach to all stakeholders to work toward meeting the goal of a smooth transition to the new system.

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Acknowledgments

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